Portable manure dispenser machine

Seena Naik Korra1, Sudarshan E2, S Venkatesulu3, P Pramod Kumar4, Bonthala Prabhanjan Yadav5

1,3,4SR University, Warangal-506371.
2,5Sumathi Reddy Institute of Technology for Women, Warangal-506371.

E-mail: seenasuna558@gmail.com

Abstract. In Indian agriculture, farmers usually use the traditional method of transporting manure to the farm by a bullock cart or tractor. Thereafter, agriculture labour's manually spread the manure through their shovels. This traditional method could take more time, expensive, and moreover it's unhealthy. These problems can be overcome by automatic fertilizer spraying system using electric motor blades and allowing it to spread uniformly. It's a portable unit and easily Plug and Play. Here, if the manure must be at least partially dry or completely dry, then it will be easy to spread over there and this manure will be made into smaller particles by the suppressor blades, which will facilitate the spreading mechanism. A special adjustments mechanism has given to spreading blades which can adjustable as per the material. Where the materials are would be either cattle manure or chemical fertilizers or douche. By using this, agricultural manure spreading time, mixing time and making as small particles time and human efforts are reduced greatly and resulting in cost reduction. The goal of this project is to reduce the time and effort required to spread manure on the farm. Most farmers in India, in particular, have adopted the old traditional methods of farming. Here we have found a solution to simplify their work. This makes the farmer feel more comfortable, relaxed and less tired by reducing human efforts due to the constantly spreading activity.

1. Introduction

Many Indian farmers in the villages have adopted old traditional methods to spread cattle manure or other fertilizers on the farm. They bring goods from ox carts or tractors to the farm. It is also very difficult to load, unload and spread using traditional methods. For that, they have to spend a lot of money, time and work very hard all day. There are many expensive technology machines available in the market to solve this problem but they are not suitable for small farm farmers. Most importantly Indian farmers have small farm lands, which is another reason why they have not attracted or adapted towards technology. If any machines are easy, portable and cost effective, everybody can be easily adapted.

We focus on finding a machine that can spread solid or liquid fertilizer (manure) on a farm. Those machine growers can easily use this device as a plug and play for their manure carrier truck in the back. If the manure is solid, the machine will break it down into smaller particles and spread it there. Small and large farm farmers prefer to use less time and less expensive machinery. One effort is enough to use these machines to spread manure on the farm so that we can reduce man power. It is used as a mixer to make organic fertilizer. This makes the machine portable so that it can be easily moved anywhere and this machine should be available to every farmer at an affordable cost. It can be reused by farmers as no technical understanding is required. It can be used for solid and liquid chemical fertilizers or organic fertilizers, so everyone will be interested in this device. It can be easily used as a mixing machine to make organic fertilizer.
2. Literature review
Some of the innovations are discussed here and these may differ from country to country in the context of adoption. The customer needs a more technologically sound or experienced person to use these innovations. However, if they want to adopt, it will be more effective with respect to price. In 1920, WJ Cook invented machines for spreading fertilizer, and the invention has spaced some distance above the usual lower reference more particularly to the type of machine designed for spreading manure, and comprising usually a wagon body to contain the manure, a beater mechanism at the rear end of the body to act on a body of material and distribute the same, and means for feeding the body of material rearward to the action of the beater mechanism. In certain machines of this type, the beater mechanism delivers the material directly to the ground, while in other types there is a special spreading device employed which receives the material from the beater mechanism and spreads the same widely over the ground [1].

In 1950, Weyer, Henry J invention relates to the fertilizer load dispenser. The main objective of the fertilizer spreading machine invention is simple in construction, easy to operate and efficient in performance. The fertilizer distributor is formed with a discharge opening at its bottom, said hopper adjacent first shaft opening, the multiplicity of blades of concern on the said shaft, the second shaft in the hopper mentioned above is connected to the first shaft and the operative so that the teeth on the said shaft are in one direction, i.e. Transmitting the wheel ratio, the discharge opening, the agitating teeth and distributor blades journaled under the third shaft are said to be faster than the speed of the first shaft as stated by the distributor blades for rotation between the third shaft and the driving gear connection said the first shaft [2] and this machine is shown in Fig.2.

In 1951, Mott invention is concerned with reducing the manual labour involved in the spreading of manure. Such work is very laborious and slow and is therefore also very expansive. According to the present invention manure is delivered in two rows on to a field by manure spreading machine trailing behind a vehicle loaded with manure and is distributed outwardly by rotating blades. The manure
spreading machine may be attached to the vehicle by hinge pins on each side and may have a castor wheel supporting the rear end of the frame of the machine. It can be left in the field which is to be spread with manure and is adapted to be quickly hitched on as successive loads are brought in for spreading [3] and is shown in fig.3.

![Figure 3. Manure spreading machine](image)

In 2000, Seymour et.al, introduced a material spreader with mobile tank for receiving and releasing waste materials such as manures. The spreader consists of an assembly consisting of one or more aggregates fitted in the tank to inform the discharge area of the material received in the tank. An opening near the discharge area allows the material to be delivered to the slinger assembly fitted outside the adjacent tank. As the tank is transported on a field the material is distributed by the slinger in a controlled pattern [4] and the system is Fig.4.

![Figure 4. Manure spreader](image)

In 2020, Becker, Harry H invented a loader bucket has material spreaders on opposing sides of the loader bucket to spread material from within the loader bucket received through discharge openings in the rear wall of the bucket from an auger located in the bottom of the bucket. Each material spreader includes a spinner formed with blades to spread the material received through the discharge openings. The material spreaders are positioned below the apex of the V-shaped bucket and operable within a path of distribution that includes an interior boundary member oriented with a forward end closer to the centre of the bucket than the rearward end to provide a distribution forwardly and laterally of the bucket. A low baffle mounted at the bottom periphery of the spinner blades forces material upwardly into a fluffy pattern. A high baffle provides a second boundary limit for the distribution of material [5] and this would be as Fig.5.
In 2020, Arthur O'Neil et al., invented a mulch cutting and spread machine is a machine designed to suck the mulch out of a vehicle's bed, pull the mulch cutting and spread machine and simultaneously suck and cut the mulch and release it through the discharge hose. The shield or other material can be quickly lifted or expanded in a combined action [6] and shown in Fig.6.

In 2020, Westcott et al., invented a manure spreader implement has a compartment for containing manure, a conveyor for displacing manure in the compartment towards a rear end of the implement, and a rotating beater assembly at the rear end of the implement for spreading the manure outwardly from the rear end of the implement. The implement further includes (i) support brackets for supporting the mounting fasteners of the beater teeth on the auger of the beater assembly in double shear, (ii) auxiliary paddles supported by removable fasteners on the auger of the beater assembly between the auger flighting above and the lower paddles of the auger below, and/or (iii) floor slats on the conveyor which have end portions of reduced internal dimension formed by crimps that allow relative sliding between the floor slats and the mounting bars on the chain of the conveyor [7] and shown in Fig.7.
3. Design and implementation of Portable Manure Dispenser Machine

We have designed and developed a portable manure dispenser according to the affordable economic capabilities of Indian farmers and anyone can easily use this dispenser as a plug and play model on the back of their trolley. In this system we have included two bars with crushed teeth, electric motors as well as parts like two manure dispenser wheels. These components work together synchronously. Basically we took dry solid manure for the experiment, the system would be torn into small particles if the manure contained large particles, therefore the small particle manure would spread easily in the field and it is shown as Fig.8. Figure 8a features a drum-like device in which (8b) toothed roll crusher mechanism deployed and also placed two dispenser wheels (8c) at both ends. We estimated what kind of fertilizer could be effectively disposed of with the help of a clogging indicator. Here this clogging index can identify the most distributable material type in the field. Dry solid manure content have dispensed perfectly[8-10].

We observed machine performance and distribution of different fertilizers and found the following results and they discussed in the next section. The type of manure is very important for distribution on the farm, for which we have taken measurement parameters called clogging index [7].

Clogging Index: Many scientists have calculated the intensity of clogging (intensity factor) during casting based on a comparison of the maximum mound flow rate at the stopper rod opening and the actual or reduced flow rate due to clogging. The clogging index is the ratio of flow rate of molten manure to the theoretical and actual flow rate.

\[CI = 1 - \frac{Q_{act}}{Q_{th}}\]  
\[\text{eq.1}\]

Where \(Q_{th}\) is the conceptually mound flow rate inside tube without clogging, kg/s and \(Q_{act}\) is the actual mound flow through the nozzle in kg/s.

Calculation \(Q_{act}\): The calculated volumetric flow rate of manure and the calculation are determined the mold or nozzle size by the continuity formula. Because casting speed and mold dimension data are constantly recorded, \(Q_{act}\) can be easily calculated on a real-time basis.

\[Q_{act} = U_g(t)X_{nozzle}(t)\]  
\[\text{eq.2}\]

Calculation \(Q_{th}\): The conceptual flow rate of mound in the absence of logging is estimated by continuity and Bernoulli’s equation expressed as,

\[Q_{th} = C_dXA(t)X\sqrt{2gH(t)}\]  
\[\text{eq.3}\]

\(C_d = \text{flow coefficient}\)

\(A(t) = \text{Nozzle available for manure flow (m2)}\)

\(g = \text{acceleration due to gravity (m/s2)}\)

\(H(t) = \text{height (m)}\)

However we have considered different types of fertilizers for the experiment, where we have calculated the flow rate of all types of fertilizers and they are shown in the results discussion below.

4. Results and discussion

For this experiment we used two different fertilizers to spread in the field and observed the machine performance. As shown in Table 1, the clearly showing relationship between Pipe hole and fertilizer

(a) Portable Manure Dispenser Model  (b) inside toothed roll crusher  (c) dispenser wheels
content and the result of the system as in the performance parameter. According to the results, chemical and cow dung fertilizers were applied in a flow of 8cm and 15cm pipe diameter and this shows the best performance here. In the other two situations the system performance is moderate. In Fig.9, the manure is well distributed when the dispenser pipe hole is 10 cm to 15 cm.

Table 1. Performance on different manures

| Description                  | Nozzle diameter | Performance | Dry Manure content (CI-%) |
|------------------------------|-----------------|-------------|---------------------------|
| Chemical fertilizers         | 6cm             | Best        | 7.5                       |
|                              | 8cm             | Moderate    | 8.5                       |
| Cow dung manure with other material | 10cm       | Moderate    | 5.8                       |
|                              | 15cm            | Best        | 7.8                       |

When the pipe diameter is 10 cm to 15 cm the manure will fly at 8 kg/sec to 12 kg/sec and it’s shown in Fig.10a. If the pipe diameter increases the manure will suddenly fall on the wheels so the spreader will not able to spread the manure properly. According to 3D fig.10b, the three parameters are optimal work; spreader setting and bulk density have been considered to show the results graphically. Here, the results are shown to have performed best in the middle of the cube. Blocks with different shades denote height curves, i.e. constant flow of different levels and optimal working width.

5. Conclusion
The performance of the spreading machine depends on the type of fertilizer and whether it is solid type or liquid type. We focus on how solid cattle manure can be spread in the form of manure. Usually the manure is a mixture of different materials, which we want to make by crushing it into small bubbles or particles before spreading it in the field. In that connection we designed and developed a portable manure crusher that has two strong dental bars that rotate in opposite directions to each other. Therefore, it produces small pieces of solid manure, which then flow to the spreading wheels and they rotate in the opposite direction to spread in the field. These wheels spread the manure according to the speed of the vehicle, such an adjustment is provided. The best feature here is that we can use this machine as a plug
and play model for the bull carts or trackers or any vehicle trolleys. This fertilizer spreading machine can provide or supply Indian farmers at reasonable cost.

6. References
[1] Cook, Willard J. "Machine for spreading fertilizer." U.S. Patent 1,328,618, issued January 20, 1920.
[2] Weyer, Henry J. "Fertilizer spreading machine." U.S. Patent 2,498,833, issued February 28, 1950.
[3] Mott, Stanley F. "Manure spreading machine." U.S. Patent 2,570,472, issued October 9, 1951.
[4] Seymour, Shaun A., and Jack W. Crane. "Manure spreading apparatus." U.S. Patent 6,047,908, issued April 11, 2000.
[5] Becker, Harry H. "Material spreader bucket for loaders." U.S. Patent 10,595,506, issued March 24, 2020.
[6] Westcott, Wayne Gordon, and Adam Jack Joseph Kraine. "Manure spreader improvements." U.S. Patent Application 16/552,054, filed March 5, 2020.
[7] Girase, N.U., Basu, S. and Choudhary, S.K., 2007. Development of indices for quantification of nozzle clogging during continuous slab casting. Ironmaking & Steelmaking, 34(6), pp.506-512.
[8] Seena Naik K and Sudarshan E 2019 Smart healthcare monitoring system using raspberry Pi on IoT platform ARPN Journal of Engineering and Applied Sciences 14(4) 872-876.
[9] Rajasri I, Guptha AVSSKS and Rao YVD 2011 Influence of Structural Aspects on the Generation Process in Planetary Gear Trains Engineering 3(10) 1018-1021 DOI: 10.4236/eng.2011.310126
[10] Mahender K, Ramesh KS and Kumar TA 2017 An efficient ofdm system with reduced papr for combating multipath fading Journal of Advanced Research in Dynamical and Control Systems 9(Special issue 14) 1939-1948