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A FIELD PROJECT REPORT

on

DOUBLE HANDED TRICKER OPERATED GRANUALAR FERTILIZER APPLICATOR

Submitted by

211FB21001	P SATISH KUMAR
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In partial fulfillment for the award of the Degree of

MASTER OF TECHNOLOGY

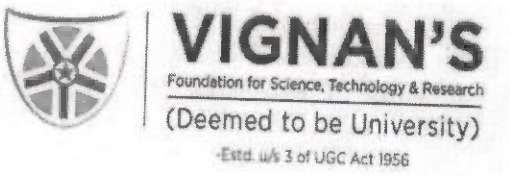
IN

AGRICULTURE ENGINEERING

Under the guidance of

Ms. Katuri Ramya Sri

Assistant Professor



DEPARTMENT OF APPLIED ENGINEERING

VIGNAN'S FOUNDATION FOR SCIENCE TECHNOLOGY & RESEARCH

VADLAMUDI

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CERTIFICATE

This is to certify that Project report titled "**Double Handed Tricker Operated Granualar Fertilizer Applicator**" is a bonafide record of work done by **P SATISH KUMAR (211FB21001), SK AFSANA (211FB21002), AASHA JYOTHI (211FB21002)** in partial fulfillment of the requirements for the award of the degree M.Tech in Agriculture Engineering of the Vignan's Foundation for Science, Technology & Research (Deemed to be university), has successfully completed the project during the academic year 2021-22.

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Project Guide

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ACKNOWLEDGEMENT

We take this opportunity to remember and acknowledge the cooperation, good will and support, both moral and technical, extended by several individuals out of which my project has evolved. We are very thankful to **Dr. N. Narayan Rao, Head of the department in Applied Engineering** for giving us this great opportunity of taking project. We would like to express our special thanks of gratitude to **Ms. Katuri Ramya Sri Assistant Professor in Applied Engineering** for his excellent guidance and constant support throughout. Finally, we wish to thanks to my friends for their support and helping during course.

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Abstract

The amount and quantity of fertilizer applied is important in today's precision agriculture. Uneven and inaccurate application of fertilizer causes abnormal and non homogeneous soil fertility which is against to the objective of precision agriculture. For the proper application of fertilizer in required quantity we need an applicator which is affordable to all categories of farmers. As the conditions and land holdings are small and fragmented, power operated granular distributors are efficient but may result in wastage of power due to its treatment away from the concentrated area. Due to high initial cost it is not affordable to small and medium scale farmers. Power operated applicator may not have versatility in spreading. The study is concerned on fertilizer application for creeper crops, where inter cultural equipment may not able to manure between the crop rows for fertilizer application. Even conventional manual dropping of fertilizer may also cause drudgery due to continuous bending during application at the root zone. Hence there is need to develop double hand operated applicator which is affordable for small scale farmers can drop and distribute the fertilizer in equal amount at concentrated area i.e. at the root zone there by reducing the wastage of fertilizer and drudgery. Maximum thrust is given for the application of wide range of crops such as green chili, tomato and creeper crop and also used for lawns, gardens and application of insecticide granules used to remove rodents and pests. Keeping in view all the factors a trigger operated applicator was developed to reduce discomfort involved in earlier developed hand operated granular applicator. The project entitled "Development and performance evaluation of the back mounted double hand trigger operated granular applicator for vegetables and creeper crops" has been carried out at VFSTR University, Vadlamudi with the following objectives.

1. To develop back mounted double hand trigger operated granular applicator for creeper and vegetables crops.
2. To evaluate performance of back mounted double hand trigger operated granular applicator

INTRODUCTION

Precision agriculture is the practice of using modern technology and agronomic principles to provide site-specific field management based on the identification and analysis of in-field variability. The driving force behind precision agriculture is the basic principle that variability naturally occurs within fields. Therefore, applying the proper inputs (such as granular fertilizers) in the right place, at the right time, in the appropriate amounts will achieve optimal yield for the entire field. Besides achieving optimal yield for the entire field, benefits to the practice of precision agriculture include improved fertilization management, increased efficiency, and reduced environmental risks, such as reduced opportunity for nutrient runoff into the water table. A granular fertilizer is dry and a tiny pellet form. It is spreadable and should be measured. A granular fertilizer can come into the natural lands synthetic form.

The ability to precisely apply fertilizer is an essential component to precision agriculture, and using a granular fertilizer is an ideal way to accomplish this. While VRT provides site- specific field information, granular fertilizer provides the precise formulation and product handling that is required when delivering individualized fertilizer solutions to different areas of a field. Other fertilizer options such as powders or unprocessed fertilizers are in consistent and often difficult to apply, but the granular fertilization process creates dry granular so for organic or inorganic materials that are consistent and easy to manage. These dry granules can even be used in existing equipment that farmers already possess.

The manually operated fertilizer broadcaster (*Anonymous, 1988*) consists of a cylindrical hopper box made of either sheet metal or special grade plastic with tapered bottom, fertilizer metering mechanism, spreading disc, transmission unit, agitator, handle and strap. The machine can cover about 1.2 ha in one h at forward speed of 2km/h. The effective width of spread is about 6.4m. The multi-purpose spreader is ideal for spreading granular or palletized materials. It holds up to 9 kg of material. It is easy to operate with the manual hand crank with a precisionrate control mechanism.

The backpack blower Motorized backpack spreaders allow the producer to apply the fertilizer to a larger area than hand held applicators. Product is distributed by airflow, Ideal for applying in parks, forestry, and orchards. The granular knapsack spreaders with granule set, allowing proper distribution of different granules based on 4setting positions. Used for larger areas.

REVIEWOFLITERATURE

In this chapter available review of literature is given regarding the design and fabrication of different types of fertilizer applicators for different crops.

Srinivas *et al.* (2014) developed the hand operated granular applicator was developed foritsversatility to drop and distribute to granules with uniform quality at the plant root zone. These applicators were developed for creeper crops. The applicator can be converted to drop and distribution application depending on necessity. The metering roller gets the drive by hand cranking the shaft of the roller. The amount of fertilizer dropping from the hopper is regulated by the fertilizer gate. This research has done in DR.NTR College of Agricultural Engineering, Bapatla.

Md.Mehedi Hasan et al. (2018)studies on manually operated push type Urea Super Granule (USG) applicator was designed and developed. There are four small drive wheels inserted in lieuof float which was fabricated using small steel rings instead of the traditional skid concept. The discharge tubes were reformed with the additional bent PVC tubes.The average effective field capacity and field efficiency of the USG applicator was 0.16 ha h-1 and 88.1%, respectively. In the field test, the average missing rate, applicator capacity, the distance amid two dropped USG, covering performance and force requirement in developed model were 6.25%, 13.21 kg h-1, 41.61 cm, 77.5% and 69.18 N.The developed applicator saves cost about nineteen times than manual operation. The developed applicator may be useful to small growers of rice growing countries like Bangladesh which not only be cost effective but will also save both time and energy.

Fulton*etal.*(2005) studied rate response assessment from various granular VRT applicators illustrated the need for standard testing protocols for VRT systems to help guide VRT software developers, equipment manufacturers, and end users.

MATERIAL AND METHODS

This chapter deals with the materials, various methods and design criteria adoptedfor "Development and performance evaluation of back mounted double hand trigger operated granular applicator for creeper and vegetable crops". This chapter is also embedded with various views of designed equipment which was further preceded for manufacturing and final development. Laboratory experiments were conducted at the workshop, VFSTR University, Vadlamudi during the year 2021-2022.

Design consideration of double hand trigger operated granular applicator

The following points were taken into consideration for designing trigger operated granular applicator.

- Selection of hopper.
- Selection off low controller.
- Diameter and length of hosepipe.
- Dimensions of trigger mechanism.
- The equipment should be simple in construction.
- It should have simple and easy adjustment.
- It should have uniformity in dropping of GU.
- It should be made with locally available materials with simple technology & versatility.
- It should be easy to repair and maintain.
- The cost of machine must be within the capacity of small and medium farmer.
- It should be light in weight and easy to operate.
- It should be suitable for operating by a single person.
- It should be operated easily with two hands.

Selection of hopper

Fertilizer hoppers can be rectangular, trapezoidal or cylindrical. The selection of hopper depends up on the density of granular fertilizer, angle of repose and various other parameters. Based on angle of repose of different material like G.I sheet, fiberglass and plastic, the plastic hopper was selected for the present study. The hopper was selected to carry a weight of 20 kg in one fill.

Selection of Flow Controller valve

Different types of valves such as compression, torsion and expansion are available in

local market. The selection of valve depends on its outer diameter, controller deflection, load applied and material used for manufacturing. To operate a trigger mechanism, the mostly used type of valve is striker compression by rubber. The striker compression rubber reduces trigger pull weight which is easy to operate *(MilesBudimir_2014).*

Material used in fertilizer applicator

Material required for applicator the equipment were procured from the local market. The major materials are as follows:

Rawmaterialusedforconstruction ofgranularapplicator

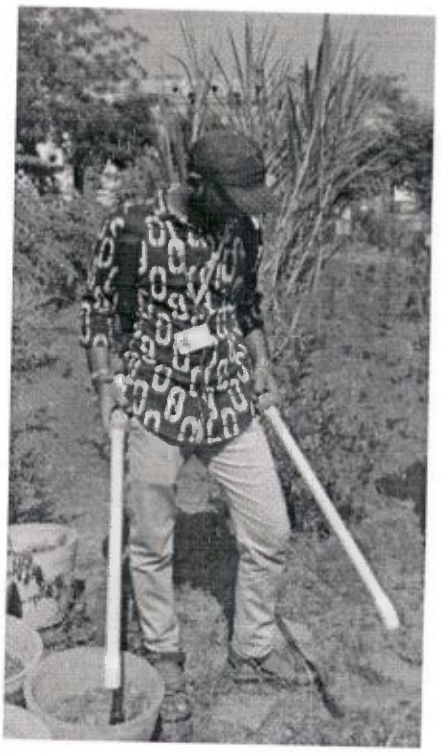
S.NO	MATERIAL	SPECIFICATIONS
1.	CPVCpipe	3mlength,outerdiameter–2.9cm Innerdiameter–2.5cm
2.	CPVC T-connector	Innerdiameter–2.93cm,outerdiameter–3.5 cm, groove width-1.5cm
3.	MSbolt	Length– 10.60cm,diameter– 0.42cm
4.	Operating hand	Double hand type
5.	Tank capacity	20kg of solid granules
6.	Hosepipe	Diameter–3.62cm,length– 80cm
7.	Back mounting iron frame (Rectangular)	Length–40cm,width–28cm

Construction of trigger mechanism with dispensing pipe

The granular applicator consist of dispensing pipe, trigger mechanism, lance, hosepipe, PVC ball valve and hopper. The dispenser pipe is made by CPVC of length 60 cm, inner diameter of 2.50cm and outer diameter of 2.90cm. A circular opening of diameter 35 cm is madeto dispensing pipe at one end and other end is kept open for discharge of fertilizer. The main function of dispensing pipe is to drop correct quantity of fertilizer perstroke. The dispensing pipeis arranged inside the controller which has free movement. The controller is made by PVC of length 60cm, Inner diameter of 2.50cm and outer diameter of 2.90 cm. A circular opening of diameter 3.5 cm is made to controller at one end and other end iskept open for discharge of fertilizer. The hose pipe of diameter 3.62 cm and length 80 cmis connected to controller through

circular opening and hopper. The dispenser pipe and controllerare linked with a compression rubber suspension of length 10 cm. Atrigger is attached to dispenser pipe and compression rubber through a slot of length 3.5 cm. when the force is applied on trigger by hand the controller and dispensing pipe are coincide attheir respective openings of diameter 3.5 cm, the metered fertilizer granular will drop through gravity until the force on trigger is removed.

Based on the opening of the dispensing pipe by trigger, that is full or half opening the quantity of granular fertilizer will drop. A PVC ball valve of length 10.50 cm is attached between hopper and hosepipe which prevents from clogging and excess dropping of fertilizer into dispenser pipe.



Working of urea applicator

Performanceevaluationofapplicator:

The developed applicator was evaluated for its performance in laboratory conditions. Various testes conducted in the laboratory conditions are given below:

Laboratoryconditions:

a) Percent over falling quantity of granular application with full opening of dispensing pipe.
b) Percent over falling quantity of granular application with half opening of dispensing pipe.

Placing of urea

RESULTS AND DISCUSSIONS

This chapter gives elaboration of results and discussions of the experiments conducted in order to fulfill the objectives of the study. The performance of the granular applicator was evaluated under laboratory conditions. Laboratory experiments were carried out to check the efficiency of metering mechanism for precise quantity of application. Laboratory experiments were conducted at the VFSTR University, Vadlamudi during the year2021-22.

Development of trigger operated granular applicator

A trigger operated granular applicator was developed by assembling parts viz.,trigger unit, hopper and back mounting frame. The details of the assembling procedure were explained in previous chapter.

Type of applicator : Back mounted double hand operated trigger type

Suitable crops : Green chili, Tomato, watermelon and other creeper and vegetables crops.

Performance evaluation granular applicator

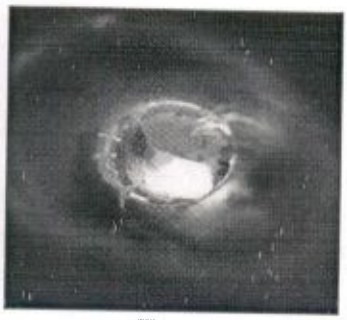
Performance evaluation was done to know the discharge rate and percent over fallingquantity in laboratory condition.

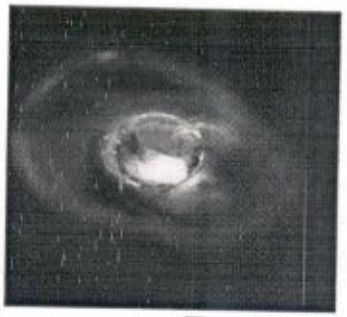
Determination of the weight of granular fertilizer under laboratory conditions

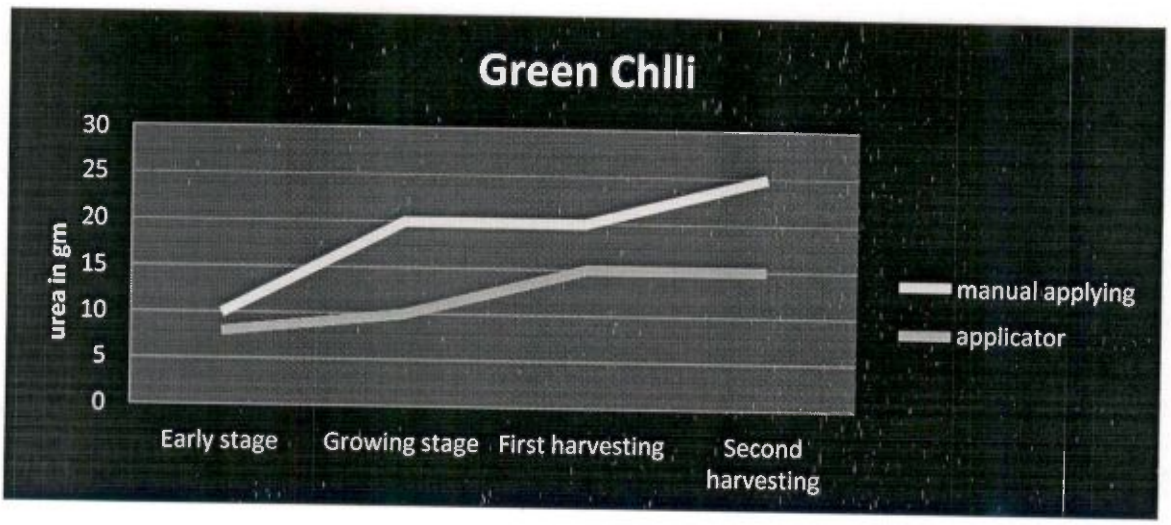
The trigger unit was operated and the weight of collected urea was measured with electrical weigh balance. Measuring the weight of urea granular fertilizer by weighing balance. Twenty samples were collected by operating the trigger in single stroke (opening and closing of dispensing pipe for one time) for each sample with full and half openings of dispensing pipe. It was observed that mean weight of the sample collected for twenty replications was 10-15 gfor full opening and 7 g for half openingof dispensing pipe, which is almost nearer to theirmode (the value that appears most often) values of dropping(10g) for full opening and(7g)for half opening. The coefficient of variance was observed as 0.15 for full opening and 0.19for half opening, which is eligible with good uniformity of fertilizer dropping. The minimum and maximum amount of fertilizer collected were10g and 15g for full opening and 5g and7g for half opening. As the standard error is 0.599 for full opening and 0.275 for half opening for twenty samples, there may not be much variation for higher amount of application (population).

Based on flow and quantity of urea required that is indicated on dispensing tubeand calibrated, the trigger can be adjusted and operated i.e., full opening of dispensing pipe having slot length of 3cm and half opening of dispensing pipe having slot length of 1.5cm.

Trigger mechanism Full opening half opening







Calculation:

1. **Green chili:**

   Scientific name: Capsicum Annuum

   Plants required/acre-15000 plants for normal variety, 9000plants for hybrid

   Urea applied for each plant -5 to 8gm/plant in early stage

   For growing crops- 10 to 15gm/ plant

   For seasonal – 3 to 4 times

   Plant spacing-60*45cm for normal, 75*60cm for hybrid

   Varieties- Teja, 334 Chilli, bedki, Roshini

SUMMARY AND CONCLUSIONS

The back mounted trigger operated granular applicator for creeper and vegetables crops was developed at workshop, Department of Farm Machinery and Power, VFSTR University, Vadlamudi. The applicator was designed according to the row to row, plant to plant spacing and can operate by pulling trigger type double handle with dispensing metering system.

The various components like pipes, frame, PVC dispensing box and trigger mechanism were selected functionally and also withstand the operational stresses. The back mounted double handtrigger operated granular applicator consists of dispensing pipe. Based on the opening of dispensingpipe either full opening or half opening the quantity of fertilizer will be dropped when trigger is operated. The performance evaluation of granular applicator was done successfully at VFSTR University, Vadlamudi. The conclusions of the related parameters under study are given below.

- The mean weight of the sample collected for twenty replications was 10-15 g for full opening and 5-7 g for half opening of dispensing pipe, which is almost nearer to their mode (the value that appears most often) values of dropping (15 g) for full opening and(7g) for half opening.

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A FIELD PROJECT REPORT

on

SOLAR POWERED AGRICULTURAL WATER PUMPING SYSTEM WITH AUTO TRACKING

Submitted by

201FB21201	K VENKATA GAVESH BABU
201FB21203	K QUINCY ADAMS

In partial fulfillment for the award of the Degree of

MASTER OF TECHNOLOGY

IN

AGRICULTURE ENGINEERING

Under the guidance of

Mr. Lokesh Madineni

Assistant Professor

VIGNAN'S
Foundation for Science, Technology & Research
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DEPARTMENT OF APPLIED ENGINEERING

VIGNAN'S FOUNDATION FOR SCIENCE TECHNOLOGY & RESEARCH

VADLAMUDI

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CERTIFICATE

This is to certify that Project report titled "**Solar Powered Agricultural Water Pumping System with Auto Tracking**" is a bonafide record of work done by **K VENKATA GAVESH BABU (201FB21201), K QUINCY ADAMS (201FB21203)** in partial fulfillment of the requirements for the award of the degree M.Tech in Agriculture Engineering of the Vignan's Foundation for Science, Technology & Research (Deemed to be university), has successfully completed the project during the academic year 2021-22.

Mr. Lokesh Madineni
Project Guide

Head of the Department

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ACKNOWLEDGEMENT

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ABSTRACT

Agricultural technology is changing rapidly. Farm machinery, farm building and production facilities are constantly being improved. Agricultural applications suitable for photovoltaic (PV) solutions are numerous. These applications are a mix of individual installations and systems installed by utility companies when they have found that a PV solution is the best solution for remote agricultural need such as water pumping for crops or livestock. A solar powered water pumping system is made up of two basic components. These are PV panels and pumps. The smallest element of a PV panel is the solar cell. Each solar cell has two or more specially prepared layers of semiconductor material that produce direct current (DC) electricity when exposed to light. This DC current is collected by the wiring in the panel. It is then supplied either to a DC pump, which in turn pumps water whenever the sun shines ,or stored in batteries for later use by the pump. The aim of this article is to explain how solar powered water pumping system works and what the differences with the other energy sources are. Key words: Agriculture, water, solar cell, pump

INTRODUCTION

It is common to use diesel to power generators in agricultural operations. While these systems can provide power where needed there are some significant drawbacks, including:

- Fuel has to be transported to the generator's location, which may be quite a distance over some challenging roads and landscape.
- Their noise and fumes can disturb livestock.
- Fuel costs add up, and spills can contaminate the land.
- Generators require a significant amount of maintenance and, like all mechanical systems, they break down and need replacement parts that are not always available.

There are also major disadvantages in using propane or bottled gas to heat water for pen cleaning or in crop processing applications, or to heat air for crop drying, including transportation to the location where you need the heat, costs of fuel and safety issues.

For many agricultural needs, the alternative is solar energy. Modern, well-designed, simple to maintain solar systems can provide the energy that is needed where it is needed, and when it is needed. These are systems that have been tested and proven around the world to be cost-effective and reliable, and they are already raising levels of agricultural productivity worldwide.

PV systems are very economical in providing electricity at remote locations on farms, ranches, orchards and other agricultural operations. A "remote" location can be as little as 15 meters from an existing power source. PV systems can be much cheaper than installing power lines and step-down transformers in applications such as electric fencing, area or building lighting, and water pumping – either for livestock watering or crop irrigation.

LITERATURE SURVEY

Photovoltaic (PV) power for irrigation is cost competitive in comparison to traditional energy sources for small-scale water pumping requirements. With the continuous increase in fossil fuel cost and reduction in peak watt cost of solar cells due to mass production, the photovoltaic power is to become further economical in future. PV powered water pumping systems have become attractive for livestock and agriculture applications in remote locations with limited access to conventional electricity. A number of studies have been carried out on performance evaluation, optimization, sizing techniques, efficiency improvement, and factors affecting system performance, economical and environmental aspects of PV pumping systems. The highlights of the research investigations are presented in this section.

PRINCIPLE OF SOLAR WATER PUMP

Solar water pumping is based on PV technology that converts sunlight into electricity to pump water. The PV panels are connected to a motor (DC or AC) which converts electrical energy supplied by the PV panel into mechanical energy which is converted to hydraulic energy by the pump. The capacity of a solar pumping system to pump water is a function of three main variables: pressure, flow, and power to the pump. For design purposes pressure can be regarded as the work done by a pump to lift a certain amount of water up to the storage tank. The elevation difference between the water source and storage tank determines the work, a pump has to do. The water pump will draw a certain power which a PV array needs to supply. A schematic of a typical direct-coupled DC solar photovoltaic water pumping system with MPPT.

SOLAR-POWERED WATER PUMPING SYSTEM CONFIGURATIONS:

There are two basic types of solar-powered water pumping systems, battery-coupled and direct-coupled. A variety of factors must be considered in Battery-coupled water pumping systems consist of photovoltaic (PV) panels, charge control regulator, batteries, pump controller, pressure switch and tank and DC water pump (Figure 3). The electric current produced by PV panels during daylight hours charges the batteries, and the batteries in turn supply power to the pump anytime water is needed. The use of batteries spreads the pumping over a longer period of time by providing a steady operating voltage to the DC motor of the pump. Thus, during the night and low light periods, the system can still deliver a constant source of water for livestock. The use of batteries has its drawbacks. First, batteries can reduce the efficiency of the overall system because the operating voltage is dictated by the batteries and not the PV panels. Depending on their temperature and how well the batteries are charged, the voltage supplied by the batteries can be one to four volts lower than the voltage produced by the panels.

In direct-coupled pumping systems, electricity from the PV modules is sent directly to the pump, which in turn pumps water through a pipe to where it is needed. This system is designed to pump water only during the day. The amount of water pumped is totally dependent on the amount of sunlight hitting the PV panels and the type of pump. Because the intensity of the sun and the angle at which it strikes the PV panel changes throughout the day, the amount of water pumped by this system also changes throughout the day. For instance, during optimum sunlight periods (late morning to late afternoon on bright sunny days) the pump operates at or near 100 percent efficiency with maximum water flow. However, during early morning and late afternoon, pump efficiency may

drop by as much as 25 percent or more under these low-light conditions. Water-storage capacity is important in this pumping system. During cloudy days, pump efficiency will drop off even more. To compensate for these variable flow rates, a good match between the pump and PV module(s) is necessary to achieve efficient operation of the system. Direct-coupled pumping systems are sized to store extra water on sunny days so it is available on cloudy days and at night. Water can be stored in a larger-than-needed watering tank or in a separate storage tank and then gravity-fed to smaller watering tanks. Water-storage capacity is important in this pumping system. Depending on their temperature and how well the batteries are charged. Two to five days' storage may be required, depending on climate and pattern of water usage. Storing water in tanks has its drawbacks. Considerable evaporation losses can occur if the water is stored in open tanks, while closed tanks big enough to store several days water supply can be expensive. Also, water in the storage tank may freeze during cold weather.

Solar Modules: - Solar electric systems are sometimes called photovoltaic systems. The word "photovoltaic" is often abbreviated PV. Most solar panels, or modules, generate direct current (DC) electricity. A group of modules is called an array.

Mounting Structures: - There are two ways to mount solar modules: either on a fixed structure or on a tracking structure. Fixed mounts are less expensive and tolerate higher wind loading but have to be carefully oriented so they face true south (not magnetic south). An array can easily be mounted on a trailer to make it portable. A tracking array follows the sun across the sky. A tracker will add at least $400 to $800 to the cost of a system, but can increase water volume by 25 percent or more in the summertime, compared to a fixed array.

Pumps: - DC water pumps in general use one-third to one-half the energy of conventional AC (alternating current) pumps. DC pumps are classed as either displacement or centrifugal, and can be either submersible or surface types. Displacement pumps use diaphragms, vanes or pistons to seal water in a chamber and force it through a discharge outlet. Centrifugal pumps use a spinning impeller that adds energy to the water and pushes into the system, similar to a water wheel. Submersible pumps, placed down a well or sump, are highly reliable because they are not exposed to freezing temperatures, do not need special protection from the elements, and do not require priming. Surface pumps, located at or near the water surface, are used primarily for moving water through a pipeline. Some surface pumps can develop high heads and are suitable for moving water long distances or to high elevations.

Storage: - Batteries are usually not recommended for solarpowered livestock watering systems because they reduce the overall efficiency of the system and add to the maintenance and cost. Instead of storing electricity in batteries.

Designing and Installing Systems: - Every pumping and stock-watering situation is unique. The average consumer is likely to be intimidated by the prospect of sizing and designing a solar pumping system, and most people need the assistance of a qualified solar dealer. In general dealers are eager to help. Many will provide a nocost proposal based on a few simple questions that can be asked over the phone. If the price seems too high, you can easily get bids from other dealers. In order to size and design a system correctly, the dealer will want to know:

- how much water you need;
- when you need the water;
- whether your water source is a stream, pond, spring, or well;
- water available in gallons per minute (gpm);
- well depth;
- how far the water needs to be pumped, and with what elevation gain;
- water quality problems (e.g., silt or high mineral content) that may damage the pump;
- how much volume is available in storage tanks and how the tanks are arranged. Installing a solar pump is a complex task, combining elements of electrical work, plumbing, and heavy construction (often including earthmoving, pouring concrete, and welding). Written instructions are not always as complete as they should be. A backhoe or tractor with a front-end loader is almost a necessity for some larger projects.

CONCLUSION

Since the increase in price per increase in unit power output of a photovoltaic system is greater than that for a diesel, gasoline, or electric system, photovoltaic power is more cost competitive when the irrigation system with which it operates has a low total dynamic head. For this reason, photovoltaic power is more cost-competitive when used to power a micro irrigation system as compared to an overhead sprinkler system. Photovoltaic power for irrigation is cost-competitive with traditional energy sources for small, remote applications, if the total system design and Utilisation timing is carefully considered and organised to use the solar energy as efficiently as possible. In the future, when the prices of fossil fuels rise and the economic advantages of mass production reduce the peak watt cost of the photovoltaic cell, photovoltaic power will become more cost-competitive and more common.

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REVIEWOFLITERATURE

In this chapter available review of literature is given regarding the design and fabrication of different types of fertilizer applicators for different crops.

Srinivas *et al.* (2014) developed the hand operated granular applicator was developed foritsversatility to drop and distribute to granules with uniform quality at the plant root zone. These applicators were developed for creeper crops. The applicator can be converted to drop and distribution application depending on necessity. The metering roller gets the drive by hand cranking the shaft of the roller. The amount of fertilizer dropping from the hopper is regulated by the fertilizer gate. This research has done in DR.NTR College of Agricultural Engineering, Bapatla.

Md.Mehedi Hasan et al. (2018)studies on manually operated push type Urea Super Granule (USG) applicator was designed and developed. There are four small drive wheels inserted in lieuof float which was fabricated using small steel rings instead of the traditional skid concept. The discharge tubes were reformed with the additional bent PVC tubes.The average effective field capacity and field efficiency of the USG applicator was 0.16 ha h-1 and 88.1%, respectively. In the field test, the average missing rate, applicator capacity, the distance amid two dropped USG, covering performance and force requirement in developed model were 6.25%, 13.21 kg h-1, 41.61 cm, 77.5% and 69.18 N.The developed applicator saves cost about nineteen times than manual operation. The developed applicator may be useful to small growers of rice growing countries like Bangladesh which not only be cost effective but will also save both time and energy.

Fulton*etal.*(2005) studied rate response assessment from various granular VRT applicators illustrated the need for standard testing protocols for VRT systems to help guide VRT software developers, equipment manufacturers, and end users.

MATERIAL AND METHODS

This chapter deals with the materials, various methods and design criteria adoptedfor "Development and performance evaluation of back mounted double hand trigger operated granular applicator for creeper and vegetable crops". This chapter is also embedded with various views of designed equipment which was further preceded for manufacturing and final development. Laboratory experiments were conducted at the workshop, VFSTR University, Vadlamudi during the year 2021-2022.

Design consideration of double hand trigger operated granular applicator

The following points were taken into consideration for designing trigger operated granular applicator.

- Selection of hopper.
- Selection off low controller.
- Diameter and length of hosepipe.
- Dimensions of trigger mechanism.
- The equipment should be simple in construction.
- It should have simple and easy adjustment.
- It should have uniformity in dropping of GU.
- It should be made with locally available materials with simple technology & versatility.
- It should be easy to repair and maintain.
- The cost of machine must be within the capacity of small and medium farmer.
- It should be light in weight and easy to operate.
- It should be suitable for operating by a single person.
- It should be operated easily with two hands.

Selection of hopper

Fertilizer hoppers can be rectangular, trapezoidal or cylindrical. The selection of hopper depends up on the density of granular fertilizer, angle of repose and various other parameters. Based on angle of repose of different material like G.I sheet, fiberglass and plastic, the plastic hopper was selected for the present study. The hopper was selected to carry a weight of 20 kg in one fill.

Selection of Flow Controller valve

Different types of valves such as compression, torsion and expansion are available in

local market. The selection of valve depends on its outer diameter, controller deflection, load applied and material used for manufacturing. To operate a trigger mechanism, the mostly used type of valve is striker compression by rubber. The striker compression rubber reduces trigger pull weight which is easy to operate *(MilesBudimir_2014).*

Material used in fertilizer applicator

Material required for applicator the equipment were procured from the local market. The major materials are as follows:

Rawmaterialusedforconstruction ofgranularapplicator

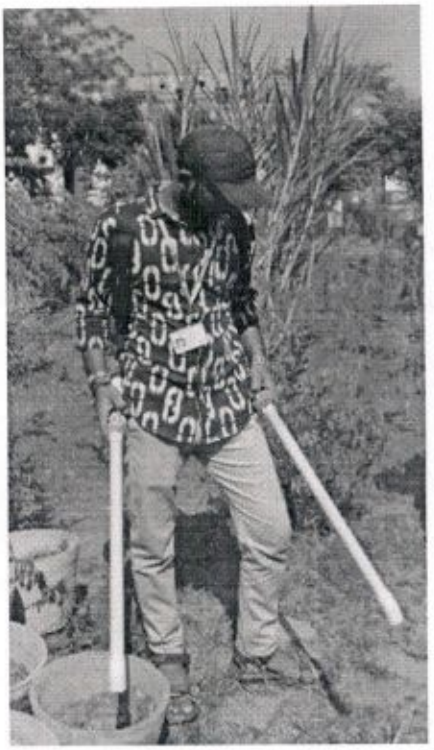
S.NO	MATERIAL	SPECIFICATIONS
1.	CPVCpipe	3mlength,outerdiameter–2.9cm Innerdiameter–2.5cm
2.	CPVC T-connector	Innerdiameter–2.93cm,outerdiameter–3.5 cm, groove width-1.5cm
3.	MSbolt	Length– 10.60cm,diameter– 0.42cm
4.	Operating hand	Double hand type
5.	Tank capacity	20kg of solid granules
6.	Hosepipe	Diameter–3.62cm,length– 80cm
7.	Back mounting iron frame (Rectangular)	Length–40cm,width–28cm

Construction of trigger mechanism with dispensing pipe

The granular applicator consist of dispensing pipe, trigger mechanism, lance, hosepipe, PVC ball valve and hopper. The dispenser pipe is made by CPVC of length 60 cm, inner diameter of 2.50cm and outer diameter of 2.90cm. A circular opening of diameter 35 cm is madeto dispensing pipe at one end and other end is kept open for discharge of fertilizer. The main function of dispensing pipe is to drop correct quantity of fertilizer perstroke. The dispensing pipeis arranged inside the controller which has free movement. The controller is made by PVC of length 60cm, Inner diameter of 2.50cm and outer diameter of 2.90 cm. A circular opening of diameter 3.5 cm is made to controller at one end and other end iskept open for discharge of fertilizer. The hose pipe of diameter 3.62 cm and length 80 cmis connected to controller through

circular opening and hopper. The dispenser pipe and controllerare linked with a compression rubber suspension of length 10 cm. Atrigger is attached to dispenser pipe and compression rubber through a slot of length 3.5 cm. when the force is applied on trigger by hand the controller and dispensing pipe are coincide attheir respective openings of diameter 3.5 cm, the metered fertilizer granular will drop through gravity until the force on trigger is removed.

Based on the opening of the dispensing pipe by trigger, that is full or half opening the quantity of granular fertilizer will drop. A PVC ball valve of length 10.50 cm is attached between hopper and hosepipe which prevents from clogging and excess dropping of fertilizer into dispenser pipe.



Working of urea applicator

Performanceevaluationofapplicator:

The developed applicator was evaluated for its performance in laboratory conditions. Various testes conducted in the laboratory conditions are given below:

Laboratoryconditions:

a) Percent over falling quantity of granular application with full opening of dispensing pipe.
b) Percent over falling quantity of granular application with half opening of dispensing pipe.

Placing of urea

RESULTS AND DISCUSSIONS

This chapter gives elaboration of results and discussions of the experiments conducted in order to fulfill the objectives of the study. The performance of the granular applicator was evaluated under laboratory conditions. Laboratory experiments were carried out to check the efficiency of metering mechanism for precise quantity of application. Laboratory experiments were conducted at the VFSTR University, Vadlamudi during the year2021-22.

Development of trigger operated granular applicator

A trigger operated granular applicator was developed by assembling parts viz.,trigger unit, hopper and back mounting frame. The details of the assembling procedure were explained in previous chapter.

Type of applicator : Back mounted double hand operated trigger type

Suitable crops : Green chili, Tomato, watermelon and other creeper and vegetables crops.

Performance evaluation granular applicator

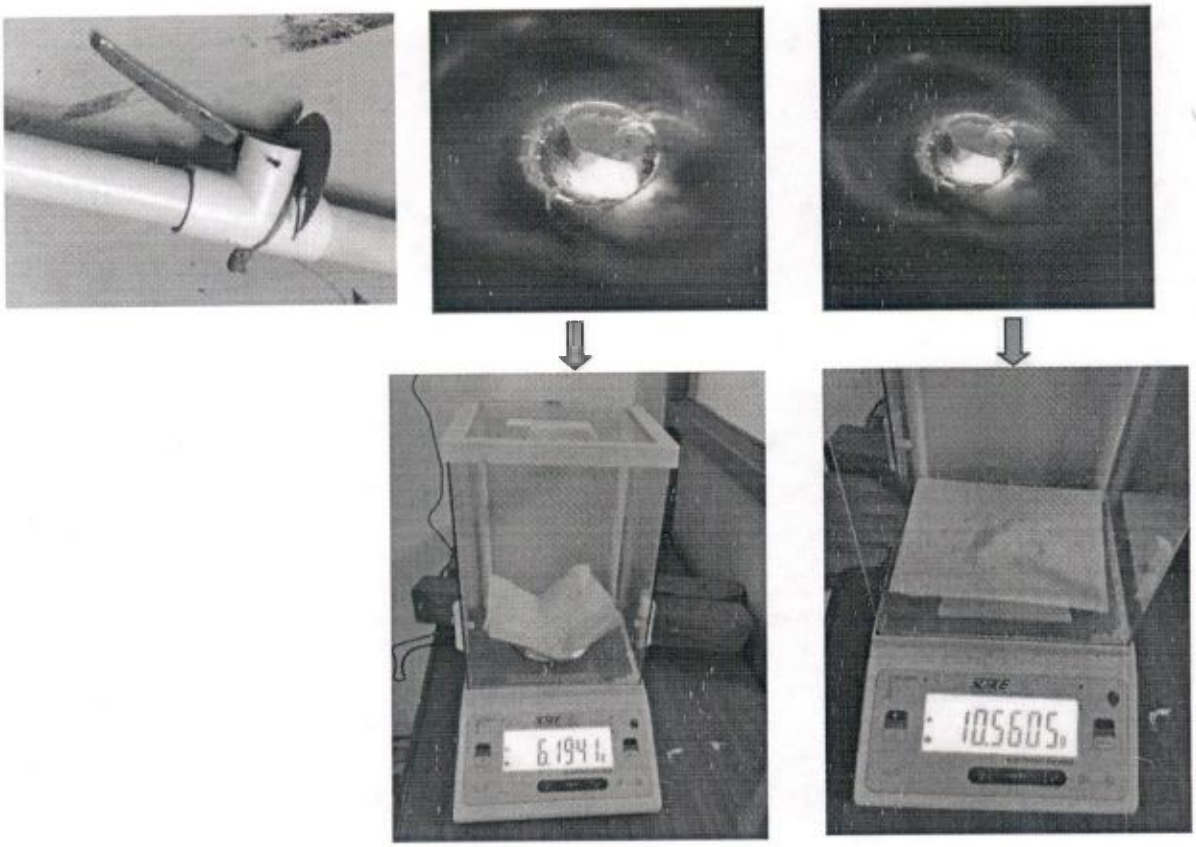
Performance evaluation was done to know the discharge rate and percent over fallingquantity in laboratory condition.

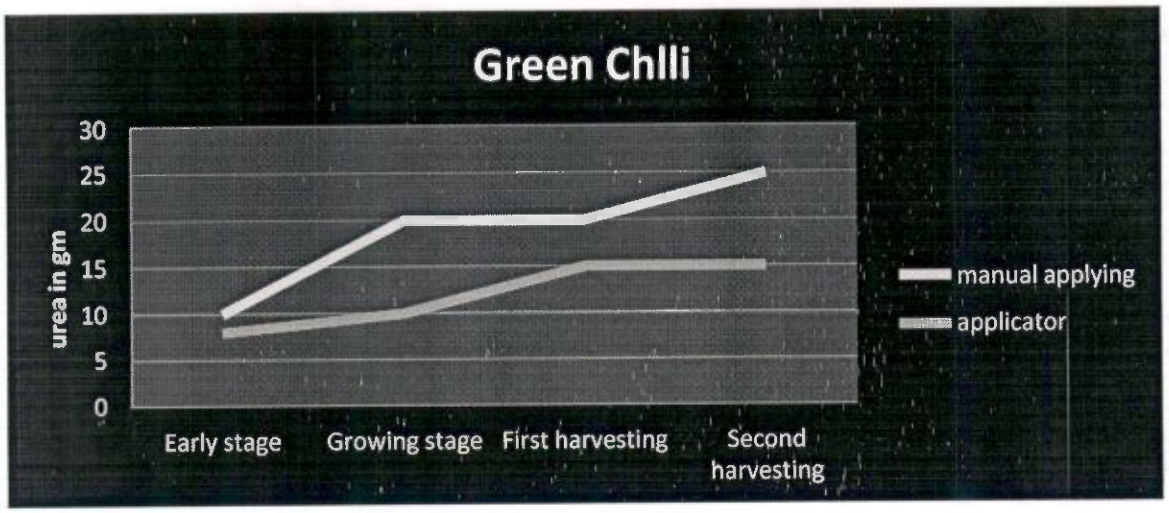
Determination of the weight of granular fertilizer under laboratory conditions

The trigger unit was operated and the weight of collected urea was measured with electrical weigh balance. Measuring the weight of urea granular fertilizer by weighing balance. Twenty samples were collected by operating the trigger in single stroke (opening and closing of dispensing pipe for one time) for each sample with full and half openings of dispensing pipe. It was observed that mean weight of the sample collected for twenty replications was 10-15 gfor full opening and 7 g for half openingof dispensing pipe, which is almost nearer to theirmode (the value that appears most often) values of dropping(10g) for full opening and(7g)for half opening. The coefficient of variance was observed as 0.15 for full opening and 0.19for half opening, which is eligible with good uniformity of fertilizer dropping. The minimumand maximum amount of fertilizer collected were10g and 15g for full opening and 5g and7gfor half opening. As the standard error is 0.599 for full opening and 0.275 for half openingfor twenty samples, there may not be much variation for higher amount of application (population).

Based on flow and quantity of urea required that is indicated on dispensing tubeand calibrated, the trigger can be adjusted and operated i.e., full opening of dispensing pipe having slot length of 3cm and half opening of dispensing pipe having slot length of 1.5cm.

Trigger mechanism Full opening half opening





Calculation:

1. **Green chili:**

   Scientific name: Capsicum Annuum

   Plants required/acre-15000 plants for normal variety, 9000plants for hybrid

   Urea applied for each plant -5 to 8gm/plant in early stage

   For growing crops- 10 to 15gm/ plant

   For seasonal – 3 to 4 times

   Plant spacing-60*45cm for normal, 75*60cm for hybrid

   Varieties- Teja, 334 Chilli, bedki, Roshini

SUMMARY AND CONCLUSIONS

The back mounted trigger operated granular applicator for creeper and vegetables crops was developed at workshop, Department of Farm Machinery and Power, VFSTR University, Vadlamudi. The applicator was designed according to the row to row, plant to plant spacing and can operate by pulling trigger type double handle with dispensing metering system.

The various components like pipes, frame, PVC dispensing box and trigger mechanism were selected functionally and also withstand the operational stresses. The back mounted double handtrigger operated granular applicator consists of dispensing pipe. Based on the opening of dispensingpipe either full opening or half opening the quantity of fertilizer will be dropped when trigger is operated. The performance evaluation of granular applicator was done successfully at VFSTR University, Vadlamudi. The conclusions of the related parameters under study are given below.

- The mean weight of the sample collected for twenty replications was 10-15 g for full opening and 5-7 g for half opening of dispensing pipe, which is almost nearer to their mode (the value that appears most often) values of dropping (15 g) for full opening and(7g) for half opening.

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