Automated Solar Powered Seed Sowing Machine

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Abstract – Today's era is marching towards the rapid growth of all sectors including the agricultural sector. To meet the future food demands, the farmers have to implement the new techniques which will not affect the soil texture but will increase the overall crop production. This Paper deals with the various sowing methods used in India for seed sowing and fertilizer placement. The comparison between the traditional sowing method and the new proposed machine which can perform a number of simultaneous operations and has number of advantages. As day by day the labor availability becomes the great concern for the farmers and labor cost is more, this machine reduces the efforts and total cost of sowing the seeds and fertilizer placement.

KeyWords: Agriculture, Seed Sowing Machine, Farmachinary, Solar Power, Microcontroller.

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1. INTRODUCTION

India is the place known for villages. This being said the major occupation of majority of villages in India is agriculture. Our whole economy is based on agriculture. Agricultural field involves the effective production of food, feed, fiber, and other goods for humans and animals. Also agriculture includes operations like production of cut flowers, timber, fertilizers, animal hides, leather, and industrial chemicals. Heavy material handling is required in the farming operations[1]. For example, in vegetable cropping, handling of heavy vegetables in organic farming, handling of heavy compost bags. Near about 70% people are dependent upon agriculture. Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support almost 17 per cent of world population from 2.3 per cent of world geographical area and 4.2 per cent of world's water resources[2][3]. The economic reforms, initiated in the country during the early 1990s, have put the economy on a higher growth trajectory. Annual growth rate in GDP has accelerated from below 6 percent during the initial years of reforms to more than 8 percent in recent years. This happened mainly due to rapid growth in non-agriculture sector. The workforce engaged in agriculture between1980-81 and 2006-07 witnessed a very small decline; from 60.5 percent to 52 percent. According to a study made by ISAE, it is found that hoes, axes and shovels are the main farm tools used by the farmers in India for agricultural operation[4][5]. These tools are conventional, time immemorial and no improvement in agricultural practice is adopted. Hence, it is necessary to develop a system which results in drudgery reduction and is user friendly to agricultural community in India. The profitability of farms depends extraordinarily on the accessibility and sensible utilization of farm force by the agriculturists. Rural actualizes and machines empower the ranchers to utilize the force sensibly for generation purposes[6][7]. Agrarian machines build efficiency of area and work by meeting convenience of homestead operations and expansion work output per unit time. Other than its foremost commitment to the different editing and enhancement of agriculture, automation likewise empowers productive usage of inputs, for example, seeds, manures and watering system water.

2. OBJECTIVE OF THE CONCEPT

The principle necessity of Automation is to diminish labor in our nation; the trendy expression in every single modern firm for the most part includes electrical, electronic segment and also mechanical part. Automation spares a considerable measure of monotonous manual work and accelerates the generation forms. Presently a day we have absence of labor. Energy required for this machine is less as contrasted and tractors or any agricultural instrument. Pollution is additionally a major issue which is dispensed with by utilizing sun based plate. A manual homestead devours additional time and prompts more contamination. So it is a period to mechanize the procedure of sowing. Another is additionally need is to build fast of operation.

2.1 Objectives

1. The main objective of this project is to design and fabricate a smart seed sowing robotic vehicle which can automatically sow seeds in the field based on variable pitch which is given as input by the farmers using the keypad present on the robot.

2. To make this vehicle Solar power so that it can be charged using the solar energy.

3. COMPONENTS USED FOR CONSTRUCTING THE MACHINE

3.1 Microcontroller

A microcontroller is a compact microcomputer designed to govern the operation of embedded systems in motor vehicles, robots, office machines, complex medical devices, mobile radio transceivers, vending machines, home appliances, and various other devices. A typical microcontroller includes a processor, memory, and peripherals.Some embedded systems are more sophisticated, while others have minimal requirements for memory and programming length and a low software complexity. Input and output devices include solenoids, LCD displays, relays, switches and sensors for data like humidity, temperature or light level, amongst others. A microcontroller (sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications[9]. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. The most sophisticated microcontrollers perform critical functions in aircraft, spacecraft, ocean-going vessels, life-support systems, and robots of all kinds. Medical technology offers especially promising future roles. For example, a microcontroller might regulate the operation of an artificial heart, artificial kidney, or other artificial body organ. Microcomputers can also function with prosthetic devices (artificial limbs). A few medical-science futurists have suggested that mute patients might someday be able, in effect, to speak out loud by thinking of the words they want to utter, while a microcontroller governs the production of audio signals to drive an amplifier and loudspeaker. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non- digital electronic systems. The microcontroller used in this project is Arduino Mega consisting of Atmega 2560. Atmega 2560 features:

The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed.

3.2 Drive Train

The drive train of the seed sowing robotic vehicle includes the prime mover with the reduction gear boxes. The drive train of a motor vehicle is the group of components that deliver power to the driving wheels which will facilitate for the navigation of the robot in field. The drive train includes the transmission, the driveshaft, the axles, and the wheels. Simply put, it works in conjunction with the engine to move the wheels. The drive train system is an essential component of a vehicle and the transmission is an integral part of the drive train. The main function of the transmission is similar to the chain on a bicycle: it keeps the engine turning in time with the wheels, regardless of what gear the vehicle is in. The drive train represents everything that is behind the transmission involved in propelling the vehicle. The main function of the drive train is basically to convey power from the vehicle's engine, through the transmission to the drive wheels on the vehicle to control the amount of torque. "Torque" is turning or twisting force.

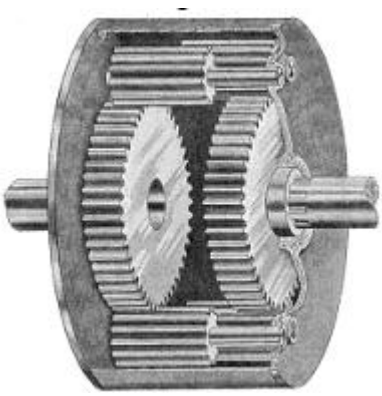

Fig.1 Typical drive train

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This project uses 35 RPM high power DC geared motors for the purpose of navigation.

3.3 Rotary Encoders

A rotary encoder, also called a shaft encoder, is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital code. It is used to stop the robot at particular pitch. Rotary encoders are also available in two formats: Incremental or absolute. Incremental optical encoders are the simplest and most commonly used. The encoder provides information about the instantaneous position of a rotating shaft by producing one square wave cycle per increment of shaft movement. Referred to as the resolution of the encoder, this increment is built directly into the device's internal hardware. Absolute optical encoders naturally have a more complicated signal structure. These encoders provide a "whole word" output with a unique code pattern that is derived from independent tracks on the encoder disc which correspond to individual photo- detectors and represents each position. The output from these detectors is HI or LO depending on the code disc pattern for that particular position. The rotary encoded is interfaced to the wheel of the robotic vehicle which rotates as the robotic vehicle rotates. This provides as closed loop control system based on which the distance is calculated and thus is the heart of the project. The rotary encoder is chosen in terms of the PPR of the rotary encoder. The PPR stands for pulse per revolution. The rotary encoder used in this project is 80 PPR rotary encoder. This means for one revolution of the rotary encoder we get 80 pulses as output. Also the shaft size of rotary encoder needs to be specified. The rotary encoder used in this project is 6mm shaft 80 PPR rotary encoder.

3.4 Keypad

A keypad is a miniature keyboard or set of buttons for operating a portable electronic device, telephone, or other equipment.

Fig.2 Membrane keypad

In this project a 4 x4 matrix keypad is used to enter the data to the seed sowing robotic vehicle.

3.5 Solar Panels

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. The primary component of a solar panel is the solar cells, or photovoltaic cell. This is the key component that converts sunlight into electricity. At the present time about 80% of all solar panels are made from crystalline silicon (i.e. monocrystalline, polycrystalline, amorphous silicon, or hybrids) solar cells. Typically the solar cells are laid out in a grid pattern – with perhaps as many as 72 different solar cells. The other 20% consist primarily of solar cells made mostly from Cadmium Telluride and a small but growing amount from CIGS. The appeal of these types of cells is their low cost resulting from the fact they can be made in large single sheets. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so the machine is usually designed with solar panels that can always be pointed at the Sun even as the rest of the body of the machine moves around.

Fig.3 Solar panel

This project uses a 10 Watt 12 V solar panel as it is sufficient to charge the battery. The technical specifications of the solar panel are as shown below.

Specifications:

Max Rated Power (Pmax)10 Watts.

Voltage at Max Power (Vmp)17.3 Volts.

Current at Max Power (Imp)0.59 Amps.

Open Circuit Voltage (Voc)21.8 Volts.

Short Circuit Current (Isc)0.64 Amps.

Length x Width x Depth (inches)13.8 x 11.8 x 0.98.

3.6 Servo Motor

The servo motor is used in this project to control the angle of the hopper. This indirectly affects the seed dropping rate thereby allowing us to have control over the rate at which the seeds are dropped when the robot is stopped at a particular pitch.

4. WORKING METHODOLOGY AND ACTION PLAN

The entire approach to the project can be divided into the following modules:

4.1 The Microcontroller Module

This is the most important module of the project. This is responsible for taking the input from farmer and processing the input and then taking the decision for robot to travel according to the pitch. This is also responsible for stopping the robot at a particular pitch. Then the seed is sowed form the seed hopper. The high-performance Atmel picopower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.2 The Robotic Vehicle

The robotic vehicle forms the integral part of this project. This consists of chassis on which all the parts are incorporated and the drive train which is responsible for sowing of seeds. The drive train consists of D.C geared motors which are driven using electrical energy stored in the battery of the robot.

4.3 The Seed Sowing Mechanism

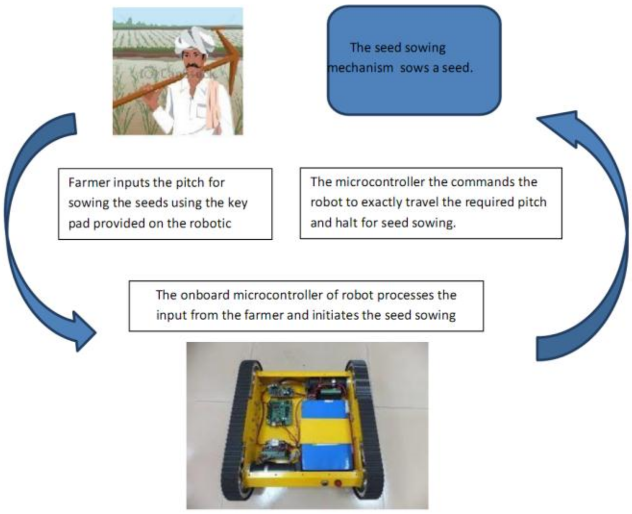
The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The seed sowing mechanism is responsible for sowing the seeds at a particular pitch. It consists of a hopper in which seeds are added and a small plough which digs the field. When the robot stops at particular pitch the seed from the hopper is sowed into the field.

4.4 The Power Unit

The power unit consists of a rechargeable battery which supplies the power for all components of the robotic vehicle. There is also a provision for charging the battery when the battery is discharged. It also contains a solar PV panel and a charge controller. The solar energy is harnessed using the solar PV panels and stored into the battery using a charge controller. Thus this robot doesn't require charging and can be charged using solar energy.

Thus by assembling all these components we can make a fully functional smart automated robotic vehicle for Indian farmers. Further the entire system is powered using solar energy which makes Indian farmers to worry less about charging of the robot and completely concentrate on their work.

5. PRINCIPLE OF OPERATION OF AUTOMATED ROBOTIC VEHICLE



The figure above shows the principle of operation of Automated Robotic Vehicle. The farmer initially inputs the pitch using the numerical keypad provided on the robot at which the robot is expected to sow the seed and initiates the seed sowing sequence. The data input of the farmer is provided to the microcontroller mounted in the robot which processes the input data. Depending on the pitch the robot then moves through the distance specified in the pitch. The distance is calculated using rotary encoders. After that, when the robot covers the respective distance the robot stops to sow the seed. When the robot stops the microcontroller signals the seed sowing mechanism to sow the seed at required pitch. Finally the entire system is solar powered which helps farmers to concentrate on agriculture without the need to remember to charge this robot. The solar panel keeps on charging the battery online whenever the battery charge drops below a particular level. Thus this vehicle forms a complete automated solution for the problems faced by the Indian farmers today.

6. DESIGN AND CALCULATIONS

6.1 Design of Shaft

As per the requirement the following motor was chosen for the robot. The details of the motor chosen are 12 V Watt Dc geared motor.

From the available motors we select the motor with following specifications Operating voltage V = 12 V

Current I = 1.8 A at load Speed = 35 rpm

As we know the total power is given by Power = Voltage x Current

P= V x I

= 12 x 1.8

= 21.6 Watt

Power of the shaft= 2 Pi N T/60 where N is the Rpm of the motor 35

T= torque transmitted P= 2x pi x 35 x T/60

T= 21.6 x 60/ 2 x pi x 35

5.89 x 1000 N-mm

No of teeth on sprocket =12

Pitch of the sprocket = .625 Inches

There for diameter of the sprocket = pcosec(180/T)

=.625 cosec (180 / 12)

=2.4181 inches

=60.91

=60 mm torque transmitted = force x radius

= 5.89 x 1000= F x 30

F=196.333 N F= 20.01 kg

Torque transmitted by the shaft is given by T=pi/16 x shear stress x dx d x d Selectable permissible shear stress as 70 N /mm square from the above formula calculate D D=7.35 mm

Taking factor of safety as 1.5 D actual = 7.35 x 1.5 D = 11 mm Therefore form data design hand book standard shat size is 12 mm D= 12 mm

Therefore according to the calculations the diameter of the shaft for the robot comes out to be 12 mm. However to provide the sufficient traction in the fields the robot needs to be made heavy. This is done to prevent the slipping of wheels in the mud of the field.

This would require the addition of additional weights onto the robot to make heavy. Considering compactness of the robot to make it feasible for Indian farmers the addition of weights will make the robot larger in size thus difficult to transport. Thus instead of adding extra weights we are using the shaft size of 20 mm which adds up to the weights.

6.2 Design of Power System

As the robot is operated using the solar panel, it is very important factor to design the power system of the robot. However the designed power system should be optimal and cost effective for farmers to afford.

Power=10 watt Voltage=12v

Therefore current= Power/Voltage P=VI

i.e I= P/V

=10/12

=0.833amps

Battery specifications 12V 7 amp

Therefore battery power is 84W

Therefore time required for complete charge of battery= 84/10 8.4 hrs

Power consumption of the robot The motor used:

Power Rating 21.6 watts

Voltage required: 12V

Therefore current required = 21.6/12

= 1.8 A during no load conditions

Power rating of Servo motor: Voltage =4.8 V

Current =0.15A

Therefore total power rating of servo motor 4.8x0.15

= 0.72 watt

Arduino microcontroller power consumption: Voltage= 5V

Current =50mA

Total power consumption on arduino board= 5 x 0.05

=0.25 watt

Therefore total power consumption of seed sowing robot 21.6+0.72+ 0.25

=17.97

=22.82 watts

The robot should be designed such that it should work atleast for three hours in field with full charge.

Total power consumption for three hours= 66 watt when load is minimal There for battery to be used: 12 V 5 AH

But commercially available is 12V 7 AH so we choose 12 V 7 AH Power capacity of battery: 84 watt

Battery backup when the battery is fully charged is : 84/22.82 =3.68 hrs

7. FRAME

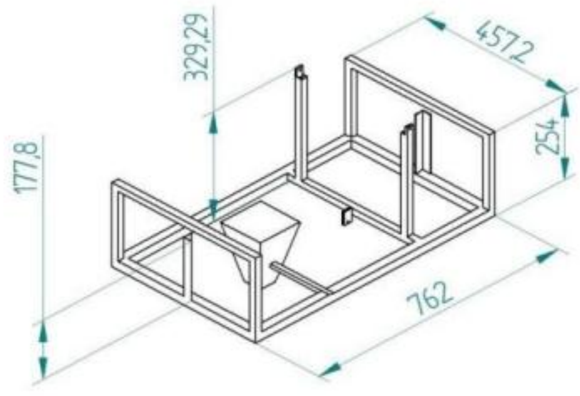


Fig.5 Frame

8. PRINCIPLE VIEWS OF A MACHINE

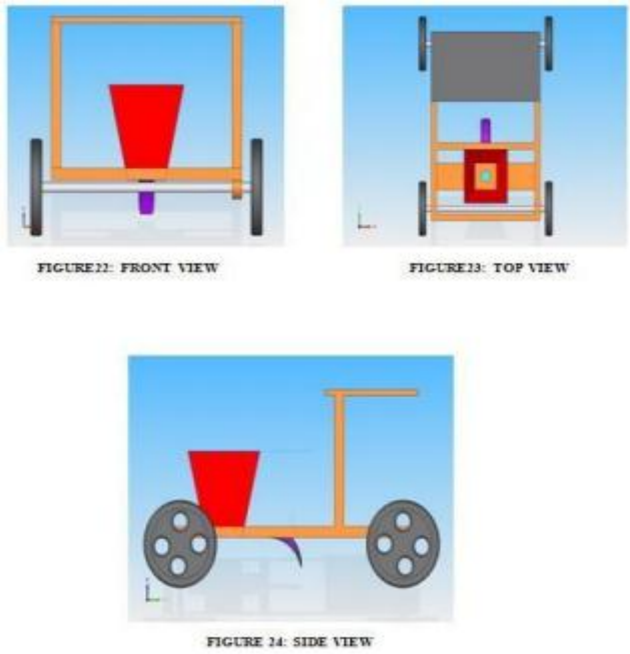


Fig.6 Machine views

9. ADVANTAGES AND DISADVANTAGES OF THE MACHINE

The report has presented the requirements and progress made towards achieving a future precision autonomous farming system. The assembly is developed for cultivating ploughed land automatically i.e. less power is required. This project increases the efficiency and accuracy. The project consists of two different mechanisms. The first mechanism contains making an assembly of vehicle and its motion, whereas second mechanism is preparing a seed bed on ploughed land. The microcontroller is used to control and monitor the process of system motion of vehicle. It is controlled with help of DC motor and servo motor. Rotary Encoder is also used for sensing distance between the two crops. The aim of solving of today's seed sowing problem is solved by this machine. Innovations in seed sowing equipment has remarkable influence in agriculture. By using this vehicle we can save more time required for seeding process. And also it reduces lot of laborer cost. It is very helpful for small scale farmers. The advantages of the smart automated robotic vehicle for Indian farmers are

Advantages

1. Reduces the effort on farmers by implementing seed sowing automation.

2. Smart pitch is maintained thought the field which can be varied using keypad.

3. Economical.

4. User friendly and can be easily operated by Indian farmers.

5. Solar powered, hence doesn't require charging.

6. Safe equipment.

Disadvantages:

1. Needs water proofing to operate in rains.

2. Some initial investment.

10. TESTING AND RESULTS

The seed sowing robotic vehicle was tested different seeds and following are the results obtained

10.1 Jowar Seeds

The jowar seeds placed in hopper effectively drop from the hopper at required distance. However the rate of seed drops is too much because of small size of the seeds.

Solution to the problem of high rate seed drop:

The above problem can be handled easily with the servo angle setting. The servo angle setting parameter is designed in the seed sowing robot and can be altered programmatically. The low servo angle setting makes seeds drop at slower rate.

10.2 Chickpea Seeds

The chick pea seeds can be effectively dropped from the seed sowing robotic vehicle without any modifications

10.3 The Groundnut

The ground nut seeds some in varying sizes. It has been observed that with optimum size seeds there is no problem sowing groundnut seeds. However with large size seeds there is probability of groundnut seeds getting stuck in hopper opening which happened few times during testing.

This problem can be solved by adding a vibrator to hopper so that the seeds don't get stuck in the hopper blocking the hopper.

11. CONCLUSION

We can conclude that present version of this vehicle as well as the future versions can be effectively used for increasing the efficiency of Indian agriculture as well as reduce the physical burden on the farmers. After considering different advantages and disadvantages of the existing machine, it is concluded that the automated robotic vehicle for farmers can

1. Maintain row spacing

2. Proper utilization of seeds can be done with less loss.

3. Perform the various simultaneous operations and hence saves labor requirement, labor cost, labor time, total cost of saving and can be affordable for the farmers.

4. Achieves automation in agricultural field.

REFERENCES

Adityakawadaskar, dr. S. S. Chaudhari"Review of methods of seed sowing and concept of multi-purposeseed sowing machine" "international journal of pure and applied research in engineering and technology"IJPRET, 2013; Volume 1(8): 267-276

S.Chandika ME AMIE, T.Mohanraj "Automation and Emerging Technology Development of 2d seed sowing robo" Journal of agricultural science, Volume 1, June 2009.

Mahesh R. Pundkar, "A seed sowing machine: A review" IJESS volume 3, Issue 3. ISSN: 2249-9482, International journal of engineering and social science.

P.P. Shelke, "frontline demonstration on bullock-drawn planter enhances yield of soya bean crop. International journal of farm science 1(2):123-128, 2011.

Singh, M.S. 197 1 . Fads about Fcrti Seed Drills. Indian Farmers' Digest. Vol . 4. No.8 pp: 54-55.

International Journal of Emerging Technology & Research Volume 1, Issue 3, Mar- Apr, 2014 (www.ijetr.org) ISSN (E): 2347-5900 ISSN(P): 2347-6079"Automatic Seed Planter Punching Type"

Vinod Kumar, R.A. Rastogi. 1975.Sow Wheat by seed-cum fertilizer drill . Indian Farmers' Digest .Vol.8. No. 11, pp:47-49.

ROY.K. and K.N.Viswanaihan., 1977. Increased agricultural productivitythrough technology - A review. Proc. National Seminar on Technologyfor Agriculture Development. Chandigarh, pp: 85-88.

Shanna, D.N., ML. Jain and Suresh Sharma, 1984. Evaluation of Notillage and conventional Tillage Systems. AMA.Vol. 15.No.3. pp,14- 18.

Devnani, R.S., B.K. Garg and T.P.Ojha. (1986) Development of animal drawn- seebcum fertilizer attachment for multipurpose tool frame. Proceeding of a seminar on accelerating fertilizer consumption in rainfed areas of Madhya Pradesh held at VallabhBhavan Bhopal. Fertilizer Association of India. Bombay, (June) 1984: pp.96- 106.

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