



AUTOMATED PESTICIDE SPRAYER MACHINE WITH GRASS CUTTER

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Abstract:

Agriculture requires several repetitive and labour-intensive operations such as grass cutting, weed removal, and pesticide spraying. Conventional methods for performing these operations require considerable human effort, time, and operating cost, while direct exposure to pesticides may create health risks for farmers and agricultural workers. To overcome these limitations, this research proposes the design and development of an Automated Pesticide Sprayer Machine with Grass Cutter that integrates grass cutting and pesticide spraying functions into a single compact agricultural machine. The proposed system consists of a motorized grass-cutting mechanism, pesticide storage tank, DC pump, spraying nozzles, drive motors, battery power supply, and an automatic control system. The machine is designed to move through the agricultural field while simultaneously or selectively performing grass cutting and pesticide spraying operations. Automation of these functions can reduce human intervention, save time and labour, and provide more uniform pesticide application. The integrated design also eliminates the need for separate machines for different field operations, thereby improving operational efficiency and reducing equipment cost. The proposed system aims to provide a simple, economical, and efficient solution for small and medium-scale agricultural applications. Experimental evaluation can be carried out based on parameters such as cutting efficiency, spraying coverage, pesticide consumption, operating time, power consumption, and overall field performance. The developed machine has the potential to improve agricultural mechanization, farmer safety, and productivity while reducing dependence on manual labour.

Keywords: Automated Agriculture, Pesticide Sprayer, Grass Cutter, Agricultural Machine, Automation, Weed Control, DC Motor, Agricultural Mechanization.

1. INTRODUCTION

Agriculture is one of the most important sectors for food production and rural development. However, many agricultural operations such as grass cutting, weed removal, and pesticide spraying still depend on manual labour. These activities are time-consuming, physically demanding, and increase the overall cost of farming. Manual pesticide spraying can also expose farmers and workers to harmful chemicals, creating potential health and safety concerns. Therefore, there is a



growing need for simple, economical, and efficient agricultural machines that can reduce human effort and improve productivity.

The proposed Automated Pesticide Sprayer Machine with Grass Cutter is designed to perform two important agricultural operations using a single mobile platform. The machine combines a motor-driven grass-cutting mechanism with a pump-based pesticide spraying system. The grass cutter helps remove unwanted grass and weeds, while the spraying unit distributes pesticides through suitable nozzles over the required area. Automation of these operations reduce manual intervention and saves valuable time and labour.

The main objective of this project is to develop a cost-effective and multifunctional machine suitable for small and medium-scale farming. The proposed system aims to improve operational efficiency, reduce direct pesticide exposure, minimize labour requirements, and provide convenient field maintenance. Thus, the machine can contribute to the modernization and mechanization of agricultural practices.

2. PROBLEM STATEMENT

Traditional grass cutting and pesticide spraying operations are generally performed manually or using separate machines. These methods require considerable labour, time, and physical effort from farmers and agricultural workers. Manual pesticide spraying can also result in direct exposure to harmful chemicals and may lead to non-uniform pesticide application. Furthermore, using separate machines for grass cutting and pesticide spraying increases equipment, operating, and maintenance costs. Conventional methods may also be less efficient when large agricultural areas need to be covered within a limited time. Therefore, there is a need for a multifunctional and automated agricultural machine that can perform both grass cutting and pesticide spraying operations efficiently. The proposed system aims to address these limitations by integrating both functions into a single mobile platform, thereby reducing labour requirements, saving time, improving operational efficiency, and minimizing direct human exposure to pesticides.

3. OBJECTIVES

- To design and develop an automated multifunctional machine for agricultural applications.
- To integrate grass cutting and pesticide spraying operations into a single machine.
- To reduce the manual labour and physical effort required for agricultural operations.
- To minimize the time required for routine agricultural field operations.
- To reduce direct human exposure to pesticides during spraying operations.
- To develop a simple, cost-effective, and multifunctional machine suitable for small- and medium-scale farms.



4. LITERATURE REVIEW

Previous studies have focused on agricultural automation, robotic grass-cutting machines, automated pesticide sprayers, and multifunctional agricultural robots. Conventional pesticide spraying systems generally require manual operation, which may increase human involvement and the risk of direct exposure to chemicals. Automated spraying systems have therefore been developed to improve spraying efficiency and reduce operator involvement.

Similarly, motorized and robotic grass-cutting machines have been developed to reduce the manual effort required for grass and weed removal. These systems demonstrate that electrically powered cutting mechanisms can provide effective and efficient field maintenance.

Some researchers have integrated grass-cutting and pesticide-spraying operations into a single robotic platform. Such systems demonstrate the feasibility of multifunctional agricultural machines capable of performing multiple field operations. However, many existing systems may involve higher cost, complex control mechanisms, or advanced components, making them less suitable for small-scale farmers.

The proposed project focuses on developing a comparatively simple, economical, and multifunctional agricultural machine by integrating a grass cutter and pesticide sprayer on a common mobile platform. The system aims to reduce manual effort, operating time, and direct human involvement while providing a practical solution for small- and medium-scale agricultural applications.

5. PROPOSED SYSTEM

1. **Mechanical Chassis** – Provides the main structural support for all components.
2. **Wheel and Drive System** – Enables the machine to move through the agricultural field.
3. **Grass-Cutting Mechanism** – Performs grass and weed cutting using a motor-driven cutting mechanism.
4. **Pesticide Storage Tank** – Stores the pesticide solution required for spraying.
5. **Pumping System** – Transfers the pesticide solution from the storage tank to the spray nozzles.
6. **Spray Nozzles** – Distribute the pesticide solution over the required area.
7. **Battery Power Supply** – Provides electrical power to the motors, pump, control unit, and other electrical components.
8. **Motor Driver** – Controls the operation and direction of the drive motors.
9. **Control Unit** – Coordinates the operation of the machine and its functional components.

During operation, the machine moves through the agricultural field using the wheel and drive system. The grass-cutting mechanism removes unwanted grass and weeds, while the pumping and spraying system distributes pesticide through the spray nozzles. By combining both operations on a single mobile platform, the proposed system aims to reduce manual effort, operating time, and the need for separate agricultural equipment.



6. PROPOSED BLOCK DIAGRAM

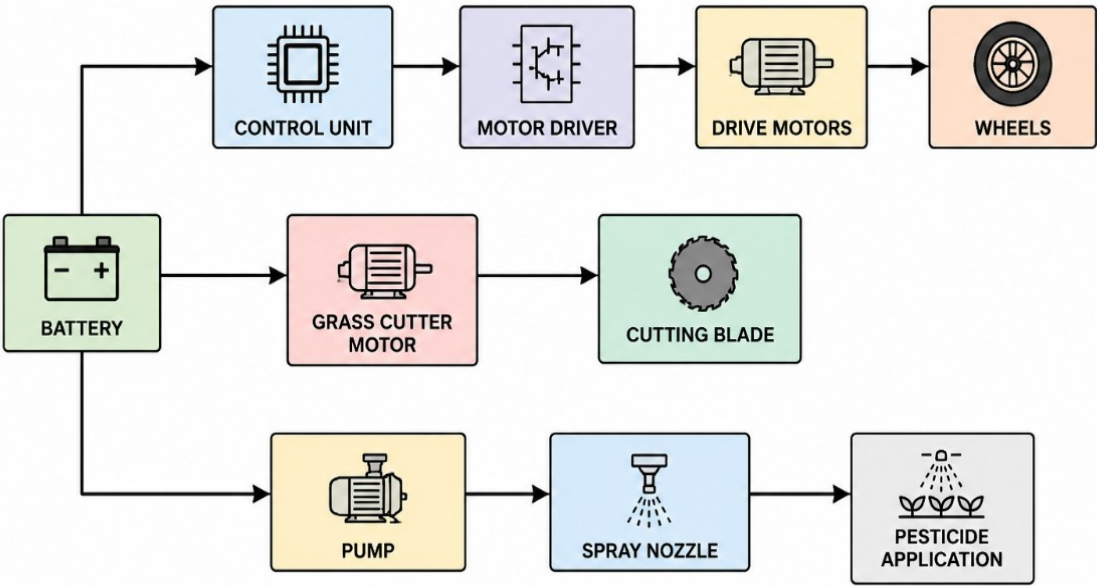


Figure 1 Block Diagram of the Automated Pesticide Sprayer Machine with Grass Cutter

MECHANICAL COMPONENTS	
Component	Purpose
Chassis/Frame	Supports all components
Wheels	Provides mobility
Cutting Blade	Cuts grass/weeds
Blade Shaft	Transfers rotational motion
Pesticide Tank	Stores pesticide solution
Nozzle Holder	Supports spray nozzles

ELECTRICAL COMPONENTS	
Component	Purpose
Battery	Main power source
DC Motors	Drive the machine
Motor Driver	Controls motor operation
Pump	Pressurizes and transfers pesticide
Switches	ON/OFF control
Wires & Connectors	Electrical connections
Controller	Controls automated operation



7. COMPONENTS REQUIRED

8. WORKING PRINCIPLE

The machine operates using a battery-powered electrical system. When the system is switched ON, the drive motors provide movement to the machine through the wheels. The grass-cutting motor rotates the cutting blade at the required speed to remove unwanted grass and weeds.

At the same time, the pesticide spraying system uses a pump to draw pesticide solution from the storage tank and deliver it to the spray nozzles. The nozzles distribute the pesticide over the required area.

Depending on the design, grass cutting and spraying can be performed simultaneously or independently. The machine can be manually controlled or automatically controlled according to the control system used.

9. METHODOLOGY

A. System Design

The overall system is designed as a mobile platform capable of performing grass cutting and pesticide spraying operations. The chassis is designed to support the mechanical and electrical components while maintaining proper balance and stability during operation.

B. Component Selection

Suitable mechanical and electrical components are selected according to the required machine performance. The major components include a chassis, wheels, cutting blade, blade shaft, pesticide tank, spray nozzles, DC motors, battery, motor driver, pump, switches, wiring, and control unit.

C. Mechanical Assembly

The chassis and wheels are assembled to form the mobile structure. The grass-cutting motor is mounted securely, and the cutting blade is connected through the blade shaft. The pesticide tank and nozzle holder are mounted on the chassis at suitable positions to maintain stability and provide effective spraying.

D. Electrical Assembly

The battery is connected to the control unit, motor driver, drive motors, grass-cutting motor, and pesticide pump. Proper wiring and connections are provided to ensure safe and reliable operation of the system.

E. Spraying System

The pesticide tank is connected to the pump using suitable pipes. The pump transfers the pesticide solution from the tank to the spray nozzles. The nozzles are positioned to provide suitable coverage of the required field area.

F. Testing and Performance Evaluation

After assembly, the machine is tested under suitable field conditions. The performance is evaluated based on grass-cutting efficiency, spraying coverage, pesticide consumption, operating time, power consumption, and machine mobility. Multiple trials can be conducted to obtain reliable performance results



Figure 2 Automated Pesticide Sprayer Machine with Grass Cutter Developed

10. DESIGN CALCULATIONS

A. Machine Footprint Area

$$\text{Length} = 1200 \text{ mm} = 1.2 \text{ m}$$

$$\text{Breadth} = 700 \text{ mm} = 0.7 \text{ m}$$

$$\text{Area} = \text{Length} * \text{Breath}$$

$$\text{Area} = 1.2 * 0.7 = 0.84 \text{ m}^2$$

Thus, the machine occupies approximately 0.84 m² of floor area.

B. Estimated Machine Speed

$$\text{Speed} = \text{distance/time}$$



$$\text{Speed} = 50/165 = 0.303 \text{ m/sec}$$

$$\text{Speed} = 18.18 \text{ m/min}$$

$$\text{Speed} = 1.09 \text{ km/hr}$$

C. Estimated Spraying Coverage

For calculation, an estimated effective spraying width of 0.70 m is considered based on the six-nozzle arrangement.

$$50 \text{ m} = 2.45 \text{ min}$$

$$50 * 20 = 1000 \text{ m}$$

$$2.45 * 20 = 55 \text{ min}$$

$$1 \text{ hour} = 1100 \text{ m}$$

Area Covered 1100m in 1 hour

11. EXPERIMENTAL SETUP

The experimental setup comprises the fabricated Automated Pesticide Sprayer Machine with Grass Cutter designed for a compact mobile agricultural platform. The machine has the overall dimensions of approximately 1200 mm × 700 mm × 900 mm and weighs around 4.28 kg.

The machine incorporates 6-number of 12 V DC drive motors having a speed of around 60 RPM. The 12 V lead acid battery is used to power the equipment directly. The grass cutting mechanism consists of a 12 V motor which is mounted on the front/bottom of the machine.

The pesticide spraying system integrates a 4 L storage tank, pump, pipes and 6-number of nozzles. The nozzles are placed on the spraying frame which ensures complete coverage over the desired area. The control and electrical systems are housed in a protection box mounted on the chassis.

12. RESULTS AND DISCUSSION

The developed Automated Pesticide Sprayer Machine with Grass Cutter was tested to determine its basic operational performance. During the test, the machine reached a measured operating speed of 1.09 km/h, and the effective spraying width was found to be approximately 0.70 m. The spraying system was able to deliver liquid through the six spray nozzles, thus providing the required spraying arrangement across the specified width.

The machine uses a 12 V battery-powered electrical system and six 12 V DC drive motors. The integrated grass-cutting and spraying mechanisms offer a multifunctional approach to agricultural field operations. It is noted that the test results suggest that the developed machine is capable of performing the intended mobility and spraying functions. Further trials under actual agricultural field conditions can be performed to evaluate cutting efficiency, liquid consumption, battery operating time, and long-term reliability.



13. ADVANTAGES

The proposed system provides the following advantages:

1. Reduces manual labour.
2. Saves operating time.
3. Combines two agricultural operations.
4. Reduces direct exposure to pesticides.
5. Provides easy field operation.
6. Reduces the need for separate equipment.
7. Can improve operational efficiency.
8. It can be designed at low cost.
9. Suitable for small and medium-scale farms.
10. Supports agricultural mechanisation

14. LIMITATIONS

The system may have some limitations:

1. Initial development and fabrication are required.
2. Limited battery operating time.
3. Machine performance depends on the ground conditions.
4. Tank capacity limits continuous spraying.
5. Cutting efficiency depends on grass type and height.
6. Regular blade maintenance is required.
7. Pump and nozzle blockage may affect spraying

15. FUTURE SCOPE

The system can be further improved by incorporating:

1. Solar-powered battery charging
2. Mobile application control
3. Bluetooth/Wi-Fi control
4. GPS-based navigation
5. Obstacle detection
6. Automatic field navigation
7. Soil and crop sensors
8. Automatic weed detection using a camera
9. Variable-rate pesticide spraying
10. IoT-based monitoring
11. AI-based crop and weed identification

These improvements could make the machine more autonomous and suitable for precision agriculture.



16. APPLICATIONS

1. The proposed machine can be used for:
2. Agricultural fields
3. Vegetable farms
4. Orchards
5. Gardens
6. Nurseries
7. Small-scale farms
8. Large open agricultural areas
9. Grass and weed maintenance

17. CONCLUSION

The Automated Pesticide Sprayer Machine with Grass Cutter is proposed to perform both grass cutting and pesticide spraying operations on a single mobile platform. The developed system can provide an efficient way to reduce manual labour, save time, reduce exposure to pesticides, and improve overall performance. By combining mechanical, electrical, and control systems, the proposed system can provide a comprehensive solution for automated agricultural operations. The experimental results, including data on cutting efficiency, spraying coverage, pesticide consumption, power consumption, and operating time, can be used to determine the performance of the developed machine. Moreover, additional improvements, such as GPS navigation, obstacle avoidance, mobile control, precision spraying, and others, should be considered to provide an efficient and autonomous system for agricultural purposes

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