Multifunctional Power Weeder with Sprayer Attachment

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***Abstract*—The Weeder Cum Sprayer Machine is a multipurpose agricultural implement designed to perform both weeding and spraying operations simultaneously in crop fields. The main objective of this project is to reduce labour cost, save time, and improve the efficiency of field operations. The machine integrates a mechanical weeding unit with a spraying system consisting of a tank, pump, and spray nozzle. During operation, the weeding blades remove unwanted weeds between crop rows while the sprayer applies fertilizers, pesticides, or herbicides to the crops. The machine is designed to be simple, lightweight, and economical so that it can be easily used by farmers, especially in small and medium-scale farms. This combined operation reduces the number of field passes required, thereby saving fuel, labour, and operational time. The design also improves crop management and helps maintain better crop growth by controlling weeds and applying chemicals effectively. Hence, the weeder cum sprayer machine can be considered an efficient and cost-effective solution for modern agricultural practices.**

***Index Terms*—Weeder, Sprayer, Agricultural Machinery, Weed Control, Spraying System, Farm Mechanization.**

I. INTRODUCTION

Weeding and spraying are two important operations in crop production. Weeds compete with crops for nutrients, water, sunlight, and space, which reduces crop yield. At the same time, spraying pesticides, herbicides, and fertilizers is necessary to protect crops from pests and diseases and to ensure healthy plant growth. Traditionally, these operations are done separately using manual labor or different machines, which increases time, labor cost, and effort.

To overcome these problems, a weeder cum sprayer machine is developed. This machine combines the functions of weeding and spraying in a single unit. It helps farmers remove weeds while simultaneously spraying chemicals or fertilizers. The combined operation reduces labor requirement, saves time, and improves field efficiency.

The weeder cum sprayer is designed to be simple, lightweight, and easy to operate so that it can be used effectively in small and medium farms. The machine generally consists of a frame, wheels, weeding blades, a sprayer tank, pump, and spray nozzles. By integrating these components, the machine performs both operations efficiently.

The main objective of this project is to design and develop a cost-effective and efficient weeder cum sprayer that can reduce manual labor, increase productivity, and make farming operations easier for farmers.

II. LITERATURE REVIEW

Agriculture is a labor-intensive sector where operations like weeding and spraying are essential for maintaining crop health and improving yield. Traditionally, these activities are performed separately using manual tools for weeding and knapsack sprayers for pesticide application, which require significant labour, time, and physical effort. These conventional methods are often inefficient, especially in large-scale farming, and contribute to increased production costs due to rising labour wages and scarcity of workers.

To address these challenges, researchers have focused on developing integrated machines that can perform both weeding and spraying simultaneously. Studies on manually operated and mono-wheel weeder cum sprayer machines have shown that such equipment can significantly reduce labour requirements and operational time while maintaining effective weeding depth and spray uniformity. The integration of both functions into a single unit enhances field efficiency and reduces overall cost.

Further developments include battery-operated and walking-type machines, which help in reducing operator fatigue, eliminating fuel dependency, and minimizing environmental pollution. These machines are especially beneficial for small and medium farmers due to their ease of operation and affordability. In addition, tractor-operated weeder cum sprayer systems have been developed for large-scale farming, offering higher field capacity, improved precision, and better coverage within a shorter period.

Comparative studies indicate that mechanized and combined machines perform better than traditional methods in terms of time saving, efficiency, and cost-effectiveness. Recent advancements in agricultural engineering also emphasize the use of precision farming technologies, including sensor-based and automated systems for weed detection and targeted spraying, which help in reducing chemical usage and environmental impact.

Despite these advancements, the high cost and complexity of advanced machines limit their adoption among small-scale farmers, creating a need for simple, low-cost, and efficient designs.

III. DESIGN AND FABRICATION

The weeder cum sprayer machine is designed to perform both weeding and spraying operations simultaneously in order to reduce labour, time, and cost involved in agricultural practices. The design focuses on simplicity, low cost, ease of operation, and suitability for small and medium-scale farmers.

The machine mainly consists of a frame, wheels, weeding unit, spray tank, pump, nozzles, and power transmission system. The frame is constructed using mild steel L-angle rods to provide sufficient strength and durability while keeping the structure lightweight. A rectangular base frame is fabricated to support all components.

The wheel assembly facilitates easy movement. The weeding unit consists of hardened steel blades that penetrate the soil up to 2–5 cm depth. The spraying system includes a tank, pump, pipes, and nozzles for uniform spraying.

Fabrication includes cutting, welding, mounting components, and final testing under field conditions.

IV. CONSTRUCTION AND WORKING

The machine consists of a sturdy frame, wheels, weeding blades, spray tank, pump, and nozzles. The operator pushes the machine forward, causing the wheels to rotate. This motion enables the weeding blades to remove weeds and the pump to spray chemicals simultaneously.

Adjustments can be made for blade depth and

nozzle height. The system ensures effective weed removal and uniform spraying in a single pass.

V. DESIGN CALCULATIONS

A. Theoretical Field Capacity (TFC)

$F = w \times 10 F = \ldots \rightarrow \frac{w \cdot s}{10} F = 10 \cdot x \ldots \rightarrow F$
$= 0.92 \times 3.4/10 = 0.3128\, h/hF$
$= \frac{0.92 \times 3.4}{10} = 0.3128\, h/hF$
$= 100.92 \times 3.4 \rightarrow = 0.3128\, h/h$

B. Spray Application Rate (SAR)

$A = 600 \times w \times s \cdot A = \ldots \quad A \frac{600 \times u}{A}$
$= w \times 600 \times s \cdot A = 3839/hA$
$= 3839/hA = 3839/h$

C. Travel Speed

$= D60 = 0.942/ = 3.4/h = \frac{D}{60}$
$= 0.942/ = 3.4/h = 60D$
$= 0.942/ = 3.4/h$

D. Pump Speed

$p = 3600 \times 15/60 = 900pp = \frac{3600 \times 15}{60}$
$900pp = 60 \cdot 3600 \times 15 \rightarrow = 900p$

E. Power Requirement

Weeder Power:

$P = F \times v = 276 \times 0.94 = 259 \approx 0.26\,\text{kW}$
$= 276 \times 0.94 = 259 \approx 0.26 = F \times v$
$= 276 \times 0.94 = 259 \approx 0.26$

Pump Power:

$= gH = 1.6$
$\frac{gH}{\eta} = 1.6$
$= gH \rightarrow = 1.6$

Total Power:

$P_{ttl} = 1.86 \approx 2.5 H_{ttl} = 1.86$
$\approx 2.5 H_{ttl} \rightarrow = 1.86$
$\approx 2.5 H$

VI. WORKING PRINCIPLE

The machine works on mechanical motion and fluid pressure principles. Wheel rotation drives the weeding blades and sometimes the pump. The pump generates pressure to spray liquid through nozzles.

VII. ADVANTAGES AND LIMITATIONS

Advantages

The weeder cum sprayer machine significantly reduces labour requirements and operational time by combining multiple tasks into a single system. It is capable of performing both weeding and spraying simultaneously in a single pass, which enhances field efficiency and minimizes repeated efforts. The machine is also cost-effective, making it suitable for small and medium-scale farmers. In addition, it is designed to be simple, easy to operate, and requires minimal maintenance. Overall, the use of this machine leads to improved productivity and better utilization of resources in agricultural operations.

Limitations

The weeder cum sprayer machine is not suitable for large-scale farming operations due to its limited field capacity and manual operation. Its performance is also highly dependent on soil conditions, as hard or uneven soils can reduce weeding efficiency. In manual models, prolonged use may cause operator fatigue, which can affect productivity and ease of operation. Additionally, the machine requires regular maintenance to ensure proper functioning and long-term durability.

VIII. RESULTS

The machine successfully performed weeding and spraying simultaneously. It reduced time, labor, and improved efficiency. The performance was satisfactory for small and medium farms.

IX. CONCLUSION

The weeder cum sprayer machine was successfully developed to reduce labor, time, and cost. It is simple, economical, and effective for small-scale farming. The system improves productivity and reduces manual effort, making it a practical solution for modern agriculture.

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