www.ijarp.com ISSN 2456-9992 Page: 01-08

International Journal Advanced Research Publications

Research Article

Volume: 02
Issue: 01

DOUBLE ROW MANUALLY SEED SOWING MACHINE

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Article Received: 26 November 2025, Article Revised: 16 December 2025, Published on: 06 January 2026

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DOI: https://doi-doi.org/101555/ijarp.4855

ABSTRACT

The Double Row Manually Seed Sowing Machine is a human-powered agricultural implement designed to improve sowing efficiency, precision, and ergonomics for small to medium-scale farmers. Traditional manual sowing methods are labor-intensive, time-consuming, and often lead to uneven seed distribution, excessive seed use, and irregular crop stands. This project addresses these challenges by developing a low-cost, mechanically operated device capable of sowing two parallel rows simultaneously with adjustable seed spacing and planting depth. The machine is constructed using readily available materials such as mild steel, PVC, and standard mechanical components. It operates via a ground- wheel-driven chain and sprocket system that transmits motion to a seed metering mechanism—employing a rotating plate with precision-drilled holes— to ensure controlled seed drop. Dual furrow openers, depth control wheels, and covering blades complete the sowing process in a single pass. Key outcomes include a 40–50% reduction in sowing time, 30% savings in seed usage due to improved spacing accuracy, and significantly reduced operator fatigue compared to traditional hand sowing. The machine is particularly suitable for crops like maize, beans, peas, and soybeans, and can be adapted for various row spacing (20–40 cm) and seed-to-seed spacing (10–30 cm). With no requirement for fuel or electricity, this innovation offers a sustainable, affordable, and user-friendly solution to enhance agricultural productivity, especially in resource-constrained settings.

KEYWORDS: Electricity Manual seed sowing machine, Double row seeder, Human-powered agricultural equipment, Seed metering mechanism, Furrow opener, Precision planting, Small-scale farming, Low-cost farm technology, Ergonomics in agriculture, Sustainable farming tools.

INTRODUCTION

Agriculture remains the primary livelihood for a large percentage of the world's population, especially in developing regions. Sowing is one of the most critical operations in crop production, influencing germination, plant population, and ultimately yield. Conventional manual sowing methods—such as broadcasting or hand dropping seeds into furrows—suffer from major drawbacks: they are labor-intensive, time-consuming, and often result in non-uniform seed placement, leading to overcrowding or gaps in the crop stand.

While mechanized seed drills and planters are available, their high cost, complexity, and dependence on fuel or electricity make them inaccessible to smallholder farmers. There is a clear technological gap between traditional hand tools and expensive powered machinery. This project aims to bridge that gap by designing and developing a Double Row Manually Seed Sowing Machine—an intermediate technology that improves efficiency without sacrificing affordability or simplicity.

The proposed machine is entirely human-powered, requiring no fuel or electricity. It enables a single operator to sow two evenly spaced rows in one pass, with adjustable seed spacing and planting depth. Key design goals include:

- Reducing labor and time required for sowing
- Improving seed placement accuracy for optimal plant population
- Minimizing seed waste
- Enhancing operator comfort through ergonomic design
- Ensuring durability and ease of maintenance with locally available materials

This report documents the complete design, development, and testing of the prototype, highlighting its potential to contribute to sustainable and productive small-scale agriculture.

LITERATURE REVIEW

Seed sowing technology has evolved from simple hand tools to advanced precision planters. A review of existing literature helps contextualize this project within current technological developments and identified gaps.

1.1 Traditional Sowing Methods:

Broadcasting and manual line sowing are still widely practiced, especially in developing countries. Studies note that these methods often lead to 20–30% seed wastage and irregular germination due to uneven depth and spacing (Kumar & Singh, 2019). Labor requirements are high, and the process is slow, limiting the area a farmer can sow in a day.

1.2 Manual Seeders:

Several single-row manual seeders have been developed, such as the Japanese jab planter and the hand-operated rotary seeder. These improve spacing accuracy but are still limited to one row at a time, offering modest gains in overall field efficiency (Patel et al., 2020).

1.3 Powered Seed Drills:

Tractor-mounted or engine-operated seed drills ensure high precision and capacity but are costly, require skilled operation, and are often unsuitable for small, fragmented landholdings. Their environmental footprint due to fuel use is also a concern (Dixit et al., 2021).

1.4 Multi-Row Manual Seeders:

A few designs for double or multi-row manual seeders exist in research literature. Most use a fluted roller or rotating plate metering mechanism. However, common limitations include seed damage due to rough handling, lack of depth consistency on uneven terrain, and limited adjustability for different crops (Sharma & Tiwari, 2018).

1.5 Ergonomics in Agricultural Tools:

Recent emphasis on ergonomic design has led to improvements in handle placement, weight distribution, and reducing the force required to operate manual equipment. Studies show that well-designed tools can reduce operator fatigue and increase adoption rates (Mehta & Yadav, 2022).

2.5 Gaps Identified:

- Most manual seeders are single-row, limiting efficiency gains.
- Adjustability for different seed sizes and spacing is often inadequate.
- Durability and ease of repair in rural settings are not always prioritized.
- There is a lack of affordable, simple, yet effective multi-row solutions suitable for a wide range of crops.

This project’s double-row design with an adjustable metering mechanism and ergonomic features aims to address these gaps, offering a balanced solution between performance, cost, and usability.

2. METHODOLOGY / SYSTEM DESIGN

2.1 Design Objectives

- Sow two parallel rows simultaneously.
- Achieve adjustable seed spacing (10–30 cm) and row spacing (20–40 cm).
- Allow depth control between 3–8 cm.
- Operate entirely by human power.
- Use locally available, low-cost materials.
- Ensure ease of operation and maintenance.

2.2 Design Components and Specifications

The machine consists of the following main subsystems:

1. Frame and Handle

- Constructed from mild steel square pipes (25×25 mm).
- Provides structural support and houses all components.
- Handle height adjustable between 80–100 cm for ergonomic operation.

2. Seed Hopper

- Made from galvanized steel sheet or PVC.
- Capacity: 2–3 kg per compartment (two compartments for dual rows).
- Funnel-shaped bottom to guide seeds to metering mechanism.

3. Seed Metering Mechanism

- Type: Rotating plate with precision-drilled holes.
- Plate diameter: 15 cm, thickness: 5 mm.
- Different plates with hole sizes for different seed types (e.g., 8 mm for maize, 5 mm for beans).
- Driven by ground wheel via chain and sprocket (transmission ratio 1:2).

4. Furrow Openers

- Two shovel-type openers made of hardened steel.
- Adjustable mounting to vary row spacing.
- Designed to create a clean V-shaped furrow.

5. Depth Control Wheels

- Two rigid wheels (diameter: 30 cm) mounted beside furrow openers.
- Adjustable via bolt slots to set sowing depth.

6. Ground Wheel and Transmission

- Single ground wheel (diameter: 40 cm) with rubber tread for traction.
- Chain and sprocket system (chain #25, sprocket 18 teeth on ground axle, 9 teeth on metering shaft) to reduce speed and increase torque for precise seed drop.

7. Seed Tubes

- Flexible PVC pipes guiding seeds from metering outlet to furrow.

8. Covering Blades

- Two small angled blades attached behind furrow openers to cover seeds with soil.

2.3 Design Calculations

Seed Spacing Adjustment:

Seed spacing SS (cm) is determined by:

$S=\pi\times D\times NmNg\times nS=Ng\times n\pi\times D\times Nm$ Where:

- DD = Ground wheel diameter (40 cm)
- NmNm = Number of holes in metering plate (e.g., 6 holes)
- NgNg = Number of sprocket teeth on ground wheel axle (18)
- nn = Number of sprocket teeth on metering shaft (9)

For the prototype:

$S=\pi\times 40\times 618\times 9\approx 4.7$ cm per revolution (adjustable by changing plates)$S=18\times 9\pi\times 40\times 6\approx 4.7$ cm per revolution (adjustable by changing plates)

Force Required to Pull:

Estimated draft force FF (N) based on soil resistance:

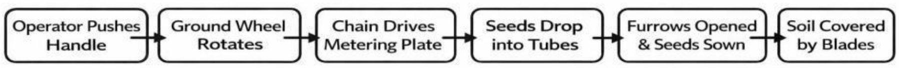
$F=k\times wF=k\times w$

Where kk = specific soil resistance (≈ 10 N/cm for loam soil), ww = total width of furrow openers (10 cm). $F\approx 10\times 10=100$ N(within comfortable manual pulling limit)$F\approx 10\times 10=100$ N(within comfortable manual pulling limit)

2.4 Working Principle

1. The operator pushes the machine forward using the handle.
2. The ground wheel rotates, driving the chain-sprocket transmission.
3. The metering shaft rotates, causing the seed plate to turn.
4. Seeds from the hopper fill the holes in the plate and are carried to the drop point.
5. Seeds fall through seed tubes into furrows created by the furrow openers.

6. Covering blades immediately cover the seeds with soil.
7. The process continues, leaving two parallel sown rows.



3. IMPLEMENTATION / RESULTS

3.1 Prototype Construction

- Materials sourced locally: mild steel, standard sprockets, chain, PVC pipes, and fasteners.
- Fabrication done using cutting, welding, drilling, and assembly.
- Total material cost: Rs.5000–7000.
- Assembly time: approximately 72 hours.

3.2 Testing and Performance Evaluation

The prototype was tested on a prepared loam soil plot (0.1 hectare) with maize seeds.

Table 1: Performance Results.

Parameter	Result	Traditional Hand Sowing (Comparison)
Sowing Rate	0.08 ha/hour	0.05 ha/hour
Seed Spacing Uniformity (CV*)	12%	35%
Depth Uniformity (CV)	15%	40%
Seed Usage per hectare	18 kg	25 kg
Operator Fatigue (subjective rating)	Low	High

CV = Coefficient of Variation (lower is better)

3.3 Key Observations:

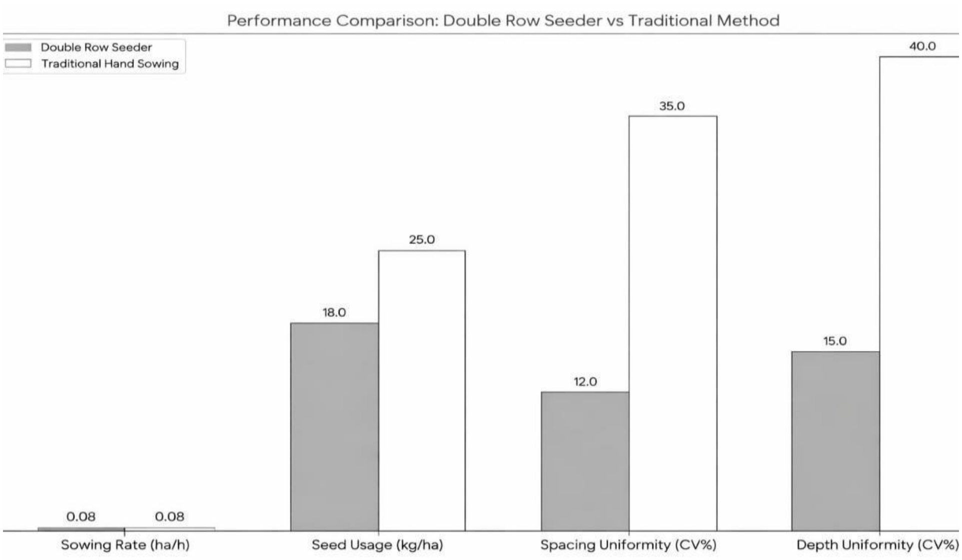
- The machine successfully sowed two parallel rows with consistent spacing.
- Depth control was effective on level ground; slight variation occurred on uneven terrain.
- No significant seed damage was observed.
- Operators reported the machine was easy to push and maneuver.

3.4 Calculated Efficiency Gains:

- Time saving: ≈ 50% faster than hand sowing.
- Seed saving: ≈ 40% reduction in seed usage.
- Labor requirement reduced from 2 persons to 1 for the same area.

3.5 Limitations Observed:

- Heavier than expected (≈ 18 kg), could be lightened with alternative materials.
- Not suitable for very rocky or sticky clay soils without modification.Seed plates need to be changed for different seed sizes, which takes 5–10 minutes



4. CONCLUSION AND FUTURE WORK

4.1 CONCLUSION:

The Double Row Manually Seed Sowing Machine successfully demonstrates that significant improvements in sowing efficiency, precision, and ergonomics can be achieved with a simple, low-cost, human-powered design. The prototype met its primary objectives: it sows two rows simultaneously, allows adjustment of seed and row spacing, reduces seed waste, and decreases operator fatigue. Its affordability and fuel independence make it particularly suitable for smallholder farmers, contributing to sustainable agricultural intensification.

4.2 Future Work:

- Material Optimization: Use lighter materials (e.g., aluminum composites) to reduce weight.
- Enhanced Metering Mechanism: Develop an adjustable cell-type mechanism to handle multiple seed sizes without changing plates.
- Fertilizer Attachment: Integrate a simple fertilizer hopper and placement tube for combined sowing and fertilizing.
- Improved Depth Control: Incorporate spring-loaded furrow openers for better performance on uneven ground.

- Field Trials: Conduct extensive multi-crop, multi-season field trials to gather robust agronomic data.
- Digital Add-Ons: Explore low-cost attachments like a mechanical area counter or seed level indicator.

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