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Design and development of seed sowing Machine

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Abstract - *Sowing seeds at the right spacing and depth strongly influences germination and final yield, yet small farms still depend mostly on slow hand sowing. This paper presents the design of a low-cost, push-type seed sowing machine for such farms. The machine is built around a frame, a seed hopper, a ground-wheel-driven cell-wheel metering unit, a furrow opener, and a handle. The metering unit keeps the gap between seeds regular, while the furrow opener holds the sowing depth steady. A parametric simulation of the design shows that a 280 mm ground wheel with four cells drops seeds about 220 mm apart, which lies within the usual spacing range for maize. The machine is expected to reduce seed wastage and labour requirement and to give small-scale farmers an affordable step towards mechanised sowing.*

Key Words: Seed Sowing Machine, Agricultural Mechanization, Seed Metering Mechanism, Uniform Seed Spacing, Sowing Depth, Seed Wastage Reduction, Low-Cost Design, Small-Scale Farming

1. INTRODUCTION

Crop establishment begins at sowing. The distance between seeds and the depth at which they are buried decide how many seedlings emerge and how well each plant competes for light, water, and nutrients. On many small holdings this work is still done by hand or with simple tools, which is tiring, slow, and prone to uneven spacing. Uneven placement leaves gaps in one part of the field and crowded plants in another, and extra seed is often used to make up for it.

Large seed drills avoid these problems but are expensive and poorly suited to small, fragmented plots. A compact push-type machine can fill this gap. Earlier work has examined seed metering mechanisms for planters and drills [1], [2], electronically controlled metering [3], [4], and laboratory set-ups for testing planters [5]. The present work takes a simpler route: a purely mechanical, ground-driven design that a single operator can push and that a local workshop can build. This paper describes the machine, explains how its metering unit fixes the seed spacing, and uses a simulation to show how the main design parameters affect the sowing result.

1.1 Objectives of the Project

- To design a simple, low-cost sowing machine that one operator can push across the field.
- To maintain uniform seed-to-seed spacing through a ground-driven metering mechanism.
- To keep the sowing depth consistent with an adjustable furrow opener.
- To reduce seed wastage and the labour and time spent on sowing.
- To use easily available materials and parts so that fabrication and repair stay affordable.

1.2 Need for the Machine

Hand sowing depends on the skill and stamina of the worker, so results differ from person to person and from hour to hour. Seeds are often dropped in clumps or skipped altogether, which lowers the plant stand and forces re-sowing or thinning. Labour is also scarce and costly during the short sowing window. A low-cost machine that places seed mechanically reduces dependence on labour, speeds up the work, and makes better use of every seed.

2. DESIGN AND METHODOLOGY

2.1 Machine Components

The frame is a welded structure that carries every other part and the handle used for pushing. The seed hopper stores the seed and feeds it to the metering unit under gravity. The metering unit is a cell wheel on a shaft that turns with the ground wheel; each cell picks up seed and releases it into the delivery tube. The ground wheel supports the machine and also supplies the drive. The furrow opener cuts a narrow groove at the chosen depth, and the delivery tube

guides the seed into that groove. Where fitted, a soil-covering device closes the groove after sowing.

2.2 Working Principle

As the operator pushes the machine, the ground wheel rotates and turns the cell wheel through the seed shaft. Each cell collects seed from the hopper, carries it round, and drops it into the delivery tube, from where it falls into the furrow. Because the drive comes from ground contact, seeds are released at fixed distance intervals whatever the walking speed. The seed spacing S is given by

$$S = (\pi \times D \times i) / n \qquad (1)$$

where D is the ground wheel diameter, i is the number of seed shaft revolutions per wheel revolution, and n is the number of cells on the seed wheel. For a row spacing R, the plant population per hectare is N = 10000 / (R × S), with R and S in metres, and the seed rate follows from N and the 1000-seed weight.

2.3 Simulation of the Design

To study the effect of the design parameters before fabrication, a simple simulator was prepared for a single-row, push-type machine with cell-wheel metering (Fig. 1). It allows the ground wheel diameter, number of cells, shaft ratio, row spacing, walking speed, 1000-seed weight, germination percentage, and hopper load to be changed, and it displays the resulting sowing pattern at once.

For a 280 mm ground wheel, four cells, and a shaft ratio of 1, Eq. (1) gives a seed spacing of about 220 mm. With a row spacing of 475 mm (Fig. 2), this corresponds to roughly 95,700 plants per hectare and a seed rate of about 28.7 kg/ha, or 31.9 kg/ha after allowing for 90 % germination. One 1 kg hopper load then sows about 348 m^2, equal to a row length of about 733 m. The simulator reports that this spacing lies within the usual 200–250 mm range for maize. More cells shorten the spacing, whereas a larger ground wheel or a higher shaft ratio lengthens it, so the same machine can be adapted to other crops by changing the seed wheel.



Fig. 1 (left): Simulator interface with the design parameters (row spacing 600 mm). Fig. 2 (right): Simulator output for 475 mm row spacing, showing seed spacing, plant population, seed rate, and area covered per hopper load.

2.4 Planned Performance Evaluation

After fabrication, the machine should be tested in the field and the measured results compared with the simulated values. The quantities to be recorded are seed spacing, sowing depth, missed and multiple placements, operating time, and field capacity.

3. CONCLUSIONS

A low-cost, push-type seed sowing machine has been designed around a ground-driven cell-wheel metering unit and an adjustable furrow opener. The spacing relation and the simulation show that the seed gap can be set by choosing the wheel diameter, number of cells, and shaft ratio, and that the selected configuration gives a spacing consistent with common maize practice. Because the design uses simple parts, it should lower labour demand and seed wastage on small farms.

Field trials are the next step to confirm the simulated spacing and depth control. Later versions could add a motor-assisted drive or sensors that detect missed seeds and record delivery data, provided the added cost remains acceptable to small-scale farmers.

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