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Performance evaluation of a rotary dibbler for chickpea sowing under on-farm trial at Dhanwad, Jalgaon

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Abstract
Precision seed placement is a key factor influencing crop establishment, productivity, and resource-use efficiency in Chickpea (chickpea). A rotary dibbler was evaluated under On-Farm Trial (OFT) conditions at Dhanwad village, Taluka and District Jalgaon, Maharashtra, during the rabi seasons of 2024-25 and 2025-26 with the participation of 20 farmers each year. The performance of rotary dibbler sowing was compared with conventional manual sowing in terms of seed placement uniformity, crop emergence, labour requirement, operational efficiency, cost of sowing, and farmer perception. The rotary dibbler recorded significantly higher seed placement uniformity (91-92%) and crop emergence (88-90%) compared to manual sowing (72-73% and 78-80%, respectively). Labour requirement was reduced by 45-50%, while time required for sowing decreased from 4.7-4.8 h ha^{-1} under manual sowing to 3.6-3.8 h ha^{-1} with the rotary dibbler. The cost of sowing was reduced by about Rs 1200-1250 per hectare due to lower labour requirement. Farmers expressed high satisfaction due to ease of operation, reduced drudgery, and uniform crop stand. The study demonstrated that the rotary dibbler is a technically feasible, economically viable, and farmer-friendly implement for Chickpea sowing, particularly suitable for small and marginal farmers.

Keywords: Rotary dibbler, gram, chickpea, on-farm trial, mechanization, crop establishment

Introduction

Chickpea (*Cicer arietinum* L.) is a major pulse crop in India, contributing substantially to dietary protein intake, soil health improvement, and farm income generation. Maharashtra is one of the important chickpea-growing states, where the crop plays a key role in enhancing nutritional security and sustaining rainfed farming systems. Achieving optimum crop establishment in chickpea is highly dependent on timely sowing and precise placement of seeds at appropriate depth and spacing, which directly influence germination, plant population, and efficient utilization of soil moisture and nutrients, ultimately affecting crop yield.

Conventional methods of chickpea sowing, predominantly carried out manually, are laborious, time-consuming, and often result in non-uniform seed placement. Such inconsistencies in depth and spacing can adversely affect crop stand and yield potential. Moreover, increasing scarcity of agricultural labour and rising wage rates have significantly escalated the cost of cultivation, particularly for small and marginal farmers. These challenges emphasize the necessity for suitable, low-cost mechanization options that enhance sowing efficiency while reducing labour dependency and production costs.

Rotary dibblers are simple and efficient precision sowing implements designed to ensure uniform seed depth and spacing. Their use has the potential to improve plant stand, enhance input use efficiency, and contribute to higher and more stable yields. In addition, reduced labour requirement and timely completion of sowing operations can lower the overall cost of cultivation, thereby improving net returns and benefit-cost ratio for farmers.

On-Farm Trials (OFTs) provide a practical platform to test improved agricultural technologies under real field conditions, allowing assessment of their agronomic performance, economic feasibility, and farmer acceptability. Demonstration of yield advantages and economic gains through OFTs plays a crucial role in accelerating technology adoption among farming communities.

Therefore, the present study was conducted to evaluate the performance of a rotary dibbler for chickpea sowing under OFT conditions at Dhanwad village of Jalgaon district, with a focus on its effect on crop yield, economics, and adoption potential among farmers.

2. Materials and Methods

2.1 Experimental Site

The On-Farm Trials (OFTs) were carried out during the rabi seasons of 2024-25 and 2025-26 at Dhanwad village, located in Jalgaon Taluka of Jalgaon district, Maharashtra. Each year, the trials involved the participation of 20 farmers. The experimental fields were characterized by clay loam soil with medium fertility status. All trials were conducted under irrigated conditions, and the crop was managed according to the recommended package of practices for chickpea cultivation.

2.2 Description of Rotary Dibbler

The rotary dibbler evaluated in the present study was a single-row, tractor-operated precision sowing implement designed for line sowing of pulse crops such as chickpea. The implement facilitates uniform placement of seeds at a predetermined depth and spacing through a rotating seed metering mechanism. It ensures precise seed drop and minimizes seed damage during operation, thereby improving crop establishment.

The major technical specifications of the rotary dibbler included a seed-to-seed spacing of 10 cm, a sowing depth of approximately 5 cm, and an effective working width of 45 cm. The implement had an operational field capacity ranging from 0.15 to 0.25 ha h^{-1}, depending on field conditions and operating speed. The rotary dibbler was operated using tractors with a power range of 35-45 hp, which are commonly owned by farmers in the study area. The implement was selected considering its suitability for small and medium landholdings, ease of operation, and compatibility with locally available farm machinery.

2.3 Experimental Design and Treatments

The On-Farm Trials were conducted using a comparative evaluation approach under farmers' field conditions to assess the performance of the rotary dibbler in relation to the conventional sowing method. The experiment consisted of two treatments:

- **T_1:** Manual sowing of chickpea (farmer's practice)
- **T_2:** Chickpea sowing using a rotary dibbler

Both treatments were implemented on each participating farmer's field during the respective cropping seasons to ensure a fair comparison. The trials were laid out under identical soil conditions and crop management practices, including land preparation, variety selection, fertilizer application, irrigation, and plant protection measures, as per the recommended package of practices. This approach helped to isolate the effect of the sowing method on crop establishment, labour requirement, and economic performance.

2.4 Observations Recorded

Various agronomic, operational, economic, and qualitative parameters were recorded to evaluate the performance of the rotary dibbler. Seed placement uniformity (%) was assessed by measuring inter-plant spacing at randomly selected locations in each plot and calculating the proportion of plants established at the desired spacing. Crop emergence (%) was determined by counting the number of emerged seedlings in a fixed area and expressing it as a percentage of the number of seeds sown.

Operational parameters such as labour requirement (person-hours ha^{-1}), time required for sowing (h ha^{-1}), and operational field capacity (ha h^{-1}) were recorded during actual field operations for both treatments. The cost of sowing (Rs ha^{-1}) was computed based on prevailing labour wages, tractor hiring charges, and implement operating costs. In addition, farmer feedback and satisfaction were documented through informal interactions and structured discussions to assess the acceptability and adoption potential of the rotary dibbler under local farming conditions.

3. Results and Discussion

3.1 Performance of Rotary Dibbler

The performance of the rotary dibbler for chickpea sowing under On-Farm Trial conditions during the rabi seasons of 2024-25 and 2025-26 at Dhanwad village is presented in Table 1. The rotary dibbler consistently ensured the recommended seed spacing (10 cm) and sowing depth (5 cm) across both years, comparable to manual sowing. However, marked improvements were observed in operational efficiency and crop establishment parameters with mechanized sowing.

Table 1: Performance of rotary dibbler in Chickpea sowing under OFT conditions at Dhanwad (2024–25 and 2025–26)

Year	Treatment	Seed spacing (cm)	Sowing depth (cm)	Seed placement uniformity (%)	Crop emergence (%)	Labour requirement (person-hrs ha^{-1})	Time required (h ha^{-1})	Operational capacity (ha h^{-1})	Cost of sowing (Rs ha^{-1})	Farmer feedback
2024–25	Manual sowing (T_1)	10	5	72	78	32	4.8	–	3200	Moderate satisfaction; high drudgery
	Rotary dibbler (T_2)	10	5	91	88	17	3.8	0.15–0.25	2000	High satisfaction; uniform crop stand
2025–26	Manual sowing (T_1)	10	5	73	80	30	4.7	–	3250	Moderate satisfaction; high drudgery
	Rotary dibbler (T_2)	10	5	92	90	16	3.6	0.15–0.25	2000	High satisfaction; willing to adopt

Seed placement uniformity achieved with the rotary dibbler ranged from 91 to 92 percent, which was substantially higher than that obtained through manual sowing (72-73%). Improved precision in seed placement directly contributed to enhanced crop emergence, which was recorded between 88 and 90 percent under rotary dibbler sowing, compared to 78-80 percent under the conventional method. Similar improvements in seed placement accuracy and crop emergence due to precision sowing implements have been reported by Kienzle *et al*. (2013) [11] and Singh *et al*. (2018) [19].

3.2 Seed Placement Uniformity and Crop Emergence

Uniformity in seed placement is a critical factor influencing early crop establishment and yield potential in chickpea. The higher seed placement uniformity observed with the rotary dibbler can be attributed to its controlled seed metering mechanism and consistent depth regulation, which minimized seed-to-seed variation. Uniform placement ensured optimum soil-seed contact, leading to improved germination and early seedling vigour.

In contrast, manual sowing resulted in uneven depth and spacing, leading to irregular emergence and patchy crop stand. The enhanced crop emergence recorded under rotary dibbler sowing corroborates earlier findings that precision sowing significantly improves germination percentage and stand establishment in pulse crops (Sharma & Singh, 2016; FAO, 2016) [16, 6].

3.3 Labour and Time Requirement

Mechanized sowing using the rotary dibbler resulted in a substantial reduction in labour requirement and time taken for sowing operations. Labour use was reduced by approximately 45-50 percent under rotary dibbler sowing (16-17 person-hours ha^{-1}) compared to manual sowing (30-32 person-hours ha^{-1}). Similarly, the time required to complete sowing operations was reduced from 4.7-4.8 h ha^{-1} under manual sowing to 3.6-3.8 h ha^{-1} with the rotary dibbler.

Reduced labour dependency and faster completion of sowing operations are particularly advantageous under conditions of labour scarcity and rising wage rates. These findings are in line with earlier studies highlighting the role of small-scale mechanization in improving timeliness and operational efficiency in pulse cultivation (Reddy, 2017; Singh *et al*., 2020) [15, 17].

3.4 Cost of Sowing

The economic analysis revealed that sowing chickpea using the rotary dibbler was more cost-effective than manual sowing. The cost of sowing with the rotary dibbler was Rs 2000 ha^{-1}, whereas manual sowing incurred a higher cost ranging from Rs 3200 to 3250 ha^{-1}. This resulted in a net saving of approximately Rs 1200-1250 ha^{-1}, primarily due to reduced labour input and lower operational time.

Cost savings achieved through mechanized sowing directly contribute to improved net returns and benefit-cost ratio, thereby enhancing farm profitability. Similar reductions in cost of cultivation due to mechanized sowing have been reported in chickpea and other pulse crops by Singh *et al*. (2018) [19] and Kumar *et al*. (2019) [12].

3.5 Farmer Feedback and Adoption Potential

Farmer feedback collected during the trials indicated a high level of satisfaction with the performance of the rotary dibbler. Farmers appreciated the ease of operation, reduced physical drudgery, uniform crop stand, and timely completion of sowing operations. In the second year of the study, all participating farmers expressed willingness to adopt the rotary dibbler for chickpea cultivation in subsequent seasons, indicating strong adoption potential.

Positive farmer perception and demonstrated economic benefits are key drivers of technology adoption. The participatory nature of OFTs played a crucial role in building farmer confidence and accelerating acceptance of the rotary dibbler, consistent with the observations of Swanson *et al*. (1997) [20] and Anderson and Feder (2004) [1].

3.6 Discussion

The results of the present study clearly demonstrate that the rotary dibbler is an effective precision sowing implement for chickpea under farmer field conditions. Improved seed placement uniformity, higher crop emergence, reduced labour and time requirements, and lower cost of sowing collectively contributed to enhanced operational efficiency and economic advantage. The findings support earlier research emphasizing that small-scale mechanization is a viable strategy for improving productivity and profitability of pulse crops, particularly for small and marginal farmers.

Overall, the rotary dibbler proved to be a simple, affordable, and farmer-friendly mechanization option that addresses key constraints of manual sowing. Its successful performance under OFT conditions highlights its suitability for wider dissemination and promotion in chickpea-growing regions.

4. Conclusions

The results of the On-Farm Trials conducted at Dhanwad village, Jalgaon, demonstrated that the rotary dibbler outperformed conventional manual sowing of chickpea by achieving superior seed placement uniformity, higher crop emergence, improved labour efficiency, and reduced cost of sowing. Consistent performance across two seasons with the participation of 20 farmers each year confirmed the technical suitability of the implement and its strong acceptance among farmers. Based on its operational efficiency, economic advantage, and positive farmer response, the rotary dibbler is recommended for large-scale promotion through extension programmes and Krishi Vigyan Kendra interventions to support sustainable and mechanized chickpea cultivation in similar agro-climatic regions.

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