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# MECHANIZATION TECHNOLOGIES FOR EFFICIENT AND SUSTAINABLE CHICKPEA SOWING

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## ABSTRACT

*Mechanization improves the timeliness, precision, and efficiency of chickpea (Cicer arietinum L.) sowing. This article reviews manually operated seeders, power-tiller-operated machines, tractor-operated seed drills, multi-crop planters, zero-till drills, pneumatic planters, and broad bed furrow (BBF) planter-cum-fertilizer applicators. Their operating principles and specifications are discussed, focusing on power requirements, seed metering, row spacing, fertilizer placement, and field capacity. Selecting and calibrating suitable machinery according to soil conditions, seed characteristics, and farm size can enhance crop establishment, operational efficiency, and resource-use efficiency, thereby supporting sustainable chickpea production.*

**KEYWORDS:** Agricultural mechanization, Broad bed furrow, Chickpea, Precision planting, Seed-cum-fertilizer drill, Seed drill, Zero tillage

## INTRODUCTION

Chickpea (Cicer arietinum L.), also known as gram or Bengal gram, is an important pulse crop grown in India. It is cultivated during the rabi season under rainfed and irrigated conditions. Sowing time varies with region, variety, soil moisture, and local climate; therefore, region-specific agronomic recommendations should be followed. In South India, the first fortnight of October to the first fortnight of November is often cited as a general sowing window, but local recommendations should take precedence.

Timely and uniform sowing is essential for establishing a good crop stand. Manual sowing over large areas can make it difficult to place seed and basal fertilizer consistently. Variation in sowing depth, row spacing, seed rate, and plant spacing may affect crop establishment and subsequent field operations.

Mechanized sowing can improve operational timeliness and placement uniformity, reduce labour demand, and support more efficient use of seed and fertilizer. The choice of machine should be based on farm size, soil condition, available power, seed characteristics, and the intended planting system.

## MECHANIZATION TECHNOLOGIES FOR CHICKPEA SOWING

The following machinery is reported as potentially relevant to chickpea sowing. Specifications are reproduced from the manuscript and cited technical descriptions where available. Values that depend on a particular model or require confirmation are identified accordingly; they should be checked against the manufacturer's or developing institute's original specification before publication.

### *1 Single-row inclined-plate planter*

The pull-type, single-row inclined-plate planter developed by ICAR–Central Institute of Agricultural Engineering (CIAE) is described as a multi-crop implement for crops including groundnut, maize, pigeon pea, mustard, chickpea, and soybean. Its suitability for small fields depends on the model and operating conditions.

| Specification | Details |
|---|---|
| Power source | Manual/pull-type (confirm exact model) |
| Number of rows | 1 |
| Seed-metering mechanism | Inclined plate; confirm exact model |
| Field capacity | 0.05–0.08 ha/h (verify source) |
| Field efficiency | 85–90% (verify source) |

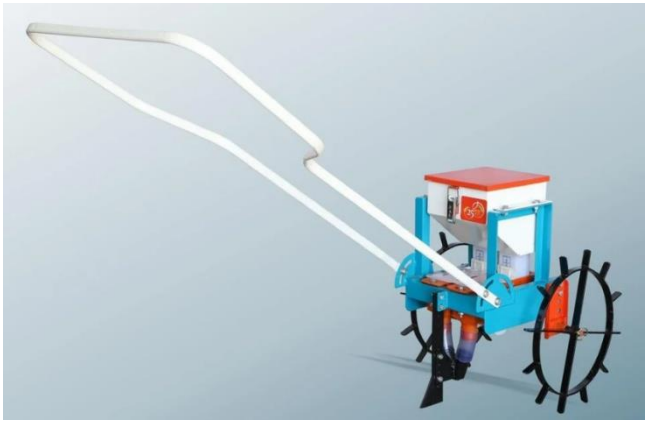

**Figure1. Single row inclined plate planter**

***2 Manually operated seed-cum-fertilizer drill***

A manually operated, portable seed-cum-fertilizer drill can place seed in rows and apply fertilizer during the same operation. The crops listed for this equipment include cotton, soybean, groundnut, maize, beans, gram, pea, pigeon pea, and mung bean. Confirm the exact model and its crop suitability before recommending it for chickpea.

| **Specification** | **Details** |
|---|---|
| Number of outlets | 14 |
| Adjustable outlet/plant spacing | 9–14 inches (verify whether this refers to row or plant spacing) |
| Sowing depth | 5.5 cm (verify model-specific recommendation) |
| Seed-box capacity | 3.5 kg |
| Fertilizer-box capacity | 5.7 kg |
| Number of seed rollers | 8 |




**Figure 2. Manual Seed cum fertilizer drill**

***3 Power-tiller-operated till-plant machine***

This machine is designed to perform tillage and planting in one pass and can sow two rows simultaneously. ICAR reports its use for wheat, soybean, Bengal gram, and sorghum in medium and heavy soils. The reported power-tiller requirement is 7.5–9.0 kW.

| Specification | Details |
|---|---|
| Number of rows | 2 |
| Power source | Power tiller |
| Power requirement | 7.5–9.0 kW |
| Operations | Tillage and planting in one pass |
| Seed and fertilizer boxes | Provided |
| Depth control | Gauge wheels |
| Effective field capacity | 0.15 ha/h |




**Figure 3. Power-Tiller Operated Till-Plant Machine**

(Source: ICAR-AICRP on FIM)

***4 Power-tiller-operated zero-till drill***

The manuscript describes an eight-row zero-till drill developed by NDUAT, Faizabad, for operation with a 10–12 hp power tiller. It is intended to place seed and fertilizer without conventional seedbed preparation. Chickpea suitability should be confirmed for the specific model and local soil conditions before making a crop-specific recommendation.

| Specification | Details |
|---|---|
| Number of rows | 8 (verify model) |
| Power source | Power tiller |
| Power requirement | 10–12 hp |
| Furrow openers | Rigid or zero-till type (verify terminology) |
| Seed and fertilizer metering | Cup-cell mechanism (verify model) |
| Hopper capacity | Seed: 15 kg; fertilizer: 20 kg |



**Figure 4. Zero-till drill machine**

***5 MPKV multi-crop planter***

The MPKV multi-crop planter is reported as suitable for groundnut, sunflower, chickpea, soybean, jowar, and wheat. It uses a vertical seed plate with peripheral cells and a fluted roller for granular fertilizer. The number of rows can be adjusted according to crop and configuration.

| Specification | Details |
|---|---|
| Number of rows | 5–9 |
| Tractor power requirement | 35 hp or above |
| Seed metering | Vertical plate with peripheral cells |
| Fertilizer metering | Fluted roller |
| Furrow openers | Spear-head type |




**Figure 5. MPKV Multi-Crop Planter**

(Source: DARE/ICAR Annual Report 2003–2004)

### *6 Mahindra multi-crop planter*

The Mahindra multi-crop planter is designed for planting a range of crops. The available configuration, seed plate, row spacing, and seed size should be checked to confirm suitability for chickpea. Avoid claiming yield improvement unless supported by comparative field data.

| Specification | Details |
|---|---|
| Number of rows | 2, 3, 4, or 6 (model dependent) |
| Tractor power requirement | 25–35 hp; 35–45 hp; or 60–75 hp, depending on configuration (verify manufacturer data) |
| Seed metering | Rotating disc with peripheral cells (verify model) |
| Fertilizer metering | Agitator and sliding orifice (verify model) |
| Maximum row spacing | 24 inches; adjustable with U-clamps (verify model) |
| Furrow openers | Shovel type for prepared/tilled fields |




**Figure 6. Mahindra multi-crop planter**

### *7 Tractor-operated zero-till seed-cum-fertilizer drill*

ICAR describes a 9-, 11-, or 13-row zero-till seed-cum-fertilizer drill developed for direct sowing of wheat in rice-harvested fields without seedbed preparation. Its reported specifications should not be assumed to establish suitability for chickpea without crop-specific validation.

| Specification | Details |
|---|---|
| Number of rows | 9, 11, or 13 |
| Power source | Tractor |
| Tractor requirement | 26 kW |
| Seed metering | Fluted roller |
| Fertilizer metering | Agitators over adjustable openings |
| Furrow opener | Inverted T-type |
| Field capacity | 0.3–0.4 ha/h |




**Figure 7. Zero-Till Seed-Cum-Fertilizer Drill**

(*Source:* ICAR-Sowing and Planting equipment)

***8 Mahindra pneumatic planter***

The pneumatic planter uses a vacuum-based metering system for precision placement. It may be considered for chickpea only if a compatible seed plate and metering configuration are available and its performance has been validated for the seed size and planting conditions.

| **Specification** | **Details** |
|---|---|
| Number of rows | 4 or 6 (model dependent) |
| Tractor requirement | 50–60 hp or above 70 hp, depending on configuration (verify model) |
| Seed metering | Vacuum-operated disc; verify model-specific mechanism |
| Fertilizer metering | Agitator and sliding orifice (verify model) |
| Minimum row spacing | 30 cm (verify model) |
| Fertilizer hopper capacity | 130 L (verify model) |
| Seed hopper capacity | 27 L (verify model) |




**Figure 8. Mahindra Pneumatic Planter**

(Source: Mahindra Pneumatic Planter – Official specifications)

***9 Conventional seed-cum-fertilizer drill***

A conventional seed-cum-fertilizer drill places seed and basal fertilizer during a single field pass. The number of rows, power requirement, metering system, and opener type vary with the model. Government of India SMAM guidelines include different tine configurations; the exact machine specifications should be taken from the selected model.

| **Specification** | **Details** |
|---|---|
| Number of rows/tines | 9, 11, or 13, depending on model |
| Power source | Tractor |
| Tractor requirement | Model- and soil-dependent |
| Seed metering | Fluted roller (where fitted) |
| Fertilizer metering | Adjustable metering system |
| Furrow opener | Shoe or tine type |
| Operation | Seed and fertilizer placement in one pass |




**Figure 9. Tractor-drawn Seed-Cum-Fertilizer Drill**

**(*Source*:** SMAM 2024 Guidelines – Government of India)

***10 Tractor-operated six-row inclined-plate planter***

The CIAE tractor-operated inclined-plate planter is a multi-crop planter. The manuscript reports adjustable row and plant spacing. Confirm that the cited specifications refer to the same model and that the selected plate is appropriate for chickpea seed.

| **Specification** | **Details** |
|---|---|
| Number of rows | 6 |
| Power source | Tractor, 35 hp or above (verify model) |
| Row spacing | 250–450 mm, adjustable (verify model) |
| Plant spacing within rows | 150–300 mm, adjustable (verify model) |
| Seed metering | Inclined plate |
| Fertilizer metering | Fluted rollers |
| Furrow opener | Shoe type |
| Time required | 2–2.5 h/ha (verify source; this is time per area, not field capacity) |



**Figure 10. Tractor-operated 6-row inclined planter**

***11 Broad bed furrow (BBF) planter-cum-fertilizer applicator***

A tractor-operated BBF planter-cum-fertilizer applicator forms broad beds and furrows while placing seed and applying fertilizer in a combined operation. Broad beds and furrows can help manage surface drainage and soil moisture where the system is appropriate. Its performance depends on soil, slope, bed dimensions, and rainfall; verify chickpea-specific performance and model specifications before making a recommendation.

| Specification | Details |
|---|---|
| Number of rows | 4 (verify model) |
| Power source | Tractor, 35 hp or above (verify model) |
| Seed metering | Inclined plate (verify model) |
| Fertilizer metering | Fluted rollers (verify model) |
| Furrow openers | Shovel type (verify model) |



**Figure 11. Broad bed furrow (BBF) planter cum fertilizer applicator**

## CONSIDERATIONS FOR SELECTING SOWING MACHINERY

- *Farm size and field layout*: manually operated or small power-tiller machines may suit small or irregular fields, whereas tractor-operated equipment may be more practical for larger fields.
- *Soil and moisture conditions*: conventional drills, zero-till drills, and BBF systems have different operating requirements. Zero-till suitability depends on residue, soil moisture, soil strength, and opener design.
- *Seed characteristics and metering*: the seed plate, roller, or pneumatic system must be compatible with chickpea seed size and shape to reduce skips, doubles, and seed damage.
- *Sowing depth and spacing*: adjust the machine to the locally recommended chickpea spacing and depth, and check seed placement in the field before full-scale operation.
- *Fertilizer placement*: calibrate fertilizer delivery separately and ensure that seed and fertilizer are placed safely according to agronomic recommendations.
- *Capacity and calibration*: report field capacity in ha/h and time required in h/ha as separate measures. Performance varies with field size, speed, turning time, soil condition, and operator skill.
- *Evidence and suitability*: distinguish manufacturer-reported specifications from measured field performance. Do not assume that a machine's general multi-crop designation proves suitability for chickpea without an appropriate seed plate and field validation.

## CONCLUSION

Mechanization offers opportunities to improve the timeliness, uniformity, and operational efficiency of chickpea sowing. Manually operated seeders, power-tiller-operated machines, tractor-mounted seed drills, multi-crop planters, zero-till drills, and broad bed furrow (BBF) planter-cum-fertilizer applicators provide options for different farm sizes and production conditions. Their performance depends on appropriate machine selection, seed-metering configuration, calibration, soil conditions, and correct adjustment of sowing depth and spacing. Equipment specifications and crop suitability should be verified against reliable technical sources before recommendation. Wider access to affordable and properly operated machinery can support efficient and sustainable chickpea production.

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