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Identification of chickpea (*Cicer arietinum* l.) genotypes suitable for mechanical harvesting

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Abstract
The rising cost and scarcity of agricultural labour during the peak harvesting period have created a need for mechanized harvesting in chickpea (*Cicer arietinum* L.). However, conventional chickpea genotypes often possess low first pod height and spreading growth habit, which limit efficient combine harvesting. The present investigation was conducted during *Rabi* 2025-26 at the Zonal Agricultural Research Station (ZARS), Kalaburagi, Karnataka, to identify chickpea genotypes with desirable plant architecture for mechanical harvesting. Twenty-five genotypes, including the mechanical-harvesting check NBeG-1267 and four other checks, were evaluated in a randomized block design with three replications. Plant height, first pod height and growth habit were considered the principal selection criteria. Plant height ranged from 42.87 cm in ICCV-231141 to 66.67 cm in KCDE-209, while first pod height ranged from 26.00 cm in ICCV-130039 to 44.73 cm in KCDE-209. Fourteen genotypes (56 %) were classified as erect and eleven (44 %) as semi-erect. KCDE-209 recorded the highest plant height and first pod height, followed by the check varieties Phule Vikram, NBeG-47 and NBeG-1267 for one or both architectural traits. Considering a plant height >50 cm, first pod height >30 cm and erect to semi-erect growth habit as desirable features, KCDE-209 was identified as the most promising genotype. ICCV-231139, ICCV-231136, ICCV-231128, ICCV-231131 were also considered as useful genotypes for further evaluation. The selected genotypes may serve as useful material for breeding chickpea varieties suitable for mechanized harvesting; however, their performance under actual combine harvesting should be confirmed across locations and seasons.

Keywords: Chickpea, first pod height, growth habit, mechanical harvesting, plant architecture

Introduction
Chickpea (*Cicer arietinum* L.) is one of the most important pulse crop in India and plays a vital role in human nutrition by providing protein, essential amino acids and other important nutrients. It also contributes to sustainable agriculture through biological nitrogen fixation, which helps to improve soil fertility and reduces the need for external nitrogen inputs (Jukanti *et al*., 2012) [2]. India is the leading producer of chickpea globally and the crop is particularly important in the semi-arid regions of Karnataka, where it supports the livelihoods of many farmers (Yadav *et al*., 2023) [8].

Despite its importance, chickpea cultivation faces several challenges, particularly the increasing cost and shortage of agricultural labour during the harvesting period. Traditional chickpea varieties often possess spreading or semi-erect growth habits, with pods located close to the ground. These characteristics make mechanical harvesting difficult and may lead to pod losses during harvesting. Manual harvesting is also time-consuming and labour-intensive, while delays in harvesting can increase the risk of losses due to unfavourable weather conditions. Therefore, identifying chickpea genotypes suitable for mechanical harvesting has become an important objective in crop improvement programmes (Reddy *et al*., 2023; Pargi Sanjay *et al*., 2024) [5, 6].

The suitability of chickpea for mechanical harvesting largely depends on its plant architecture. Genotypes with erect to semi-erect growth habit, adequate plant height, higher first pod height and uniform maturity are generally preferred for efficient combine harvesting. In particular, greater first pod height allows the cutter bar to pass beneath the lower pods, helping to reduce gathering losses. Plant height >50 cm and first pod height >30 cm are useful preliminary selection criteria for identifying promising genotypes, although actual harvesting performance also depends on other plant and machine characteristics (Gaur, 2018; Kuzbakova *et al*., 2022) [3, 9].

Previous studies have highlighted the importance of improving plant architecture to facilitate mechanization in chickpea. The development and identification of suitable genotypes can help reduce dependence on manual labour, improve harvesting efficiency and support timely crop harvesting. Therefore, the present study was undertaken with the objective of identifying chickpea genotypes suitable for mechanical harvesting based on plant height, first pod height and growth habit.

Material and methods
The field experiment was conducted during *Rabi* 2025-26 at the Zonal Agricultural Research Station (ZARS), Kalaburagi, Karnataka. Twenty-five chickpea genotypes, including five checks, were evaluated in a randomized block

design with three replications. Each genotype was sown in four rows of 4.0 m length, with 30 cm spacing between rows and 10 cm between plants. Sowing was carried out on 25th October 2025 by hand dibbling and thinning was performed 15 days after sowing. Recommended agronomic and plant-protection practices were followed.

Observations on plant height and first pod height were recorded from five randomly selected competitive plants per genotype per replication at maturity. Growth habit was classified as erect or semi-erect. Genotypes with plant height >50 cm, first pod height >30 cm and erect to semi-erect growth habit were considered promising criteria for mechanical harvesting.

Results and discussion

Considerable variation was observed among the 25 chickpea genotypes for the architectural traits considered in relation to mechanical harvesting. Plant height ranged from 42.87 cm in ICCV-231141 to 66.67 cm in KCDE-209. First pod height ranged from 26.00 cm in ICCV-130039 to 44.73 cm in KCDE-209. Fourteen genotypes (56 %) displayed an erect growth habit, whereas eleven (44 %) were classified as semi-erect. The observed variation indicated that the evaluated material contained genotypes with contrasting levels of ground clearance and plant stature, providing opportunities to identify promising machine-harvesting types.

KCDE-209 recorded the highest plant height (66.67 cm) and first pod height (44.73 cm), exceeding the mechanical-harvesting check NBeG-1267 (60.40 and 38.60 cm, respectively). Phule Vikram recorded 60.20 cm plant height and 43.20 cm first pod height, while NBeG-47 recorded 61.07 cm and 41.47 cm, respectively. Among the advanced breeding lines, ICCV-231139 (55.07 cm; 34.27 cm), ICCV-231136 (54.80 cm; 33.33 cm), ICCV-231128 (53.20 cm; 33.60 cm), ICCV-231131 (51.00 cm; 35.27 cm), ICCV-231138 (51.60 cm; 34.13 cm), ICCV-231143 (50.80 cm; 33.40 cm), ICCV-231144 (51.93 cm; 32.80 cm), ICCV-231125 (51.87 cm; 32.13 cm), ICCV-231129 (54.00 cm; 31.87 cm) and ICCV-231132 (52.47 cm; 31.67 cm) met both numerical thresholds.

ICCV-231133 had a first pod height of 37.07 cm, despite its mean plant height being slightly below the 50 cm screening threshold (49.53 cm). This suggests that selection based only on overall plant height could overlook genotypes with useful lower-pod clearance. Conversely, genotypes with adequate plant height but first pod height below 30 cm, such as ICCV-231109 and ICCV-231108, would require further consideration before being prioritized for mechanical harvesting. The two traits should therefore be assessed together with growth habit and standing ability.

The importance of tall, erect plant type and greater first pod height for reducing losses during mechanical harvesting has also been emphasized in earlier chickpea studies (Vishnu *et al*., 2018; Kuzbakova *et al*., 2022; Reddy *et al*., 2023) [3, 6, 7]. The present observations are consistent with this approach: KCDE-209 was the most important genotype based on the two measured architectural traits, while several ICCV breeding lines displayed values above the preliminary selection thresholds.

Table 1: Mean plant height, first pod height and growth habit of chickpea genotypes evaluated for mechanical harvesting

Sl. No.	Genotype	Growth habit	Plant height (cm)	First pod height (cm)
1	ICCV-231106	Semi-erect	45.20	29.33
2	ICCV-231144	Semi-erect	51.93	32.80
3	ICCV-231136	Erect	54.80	33.33
4	ICCV-231132	Erect	52.47	31.67
5	ICCV-231141	Erect	42.87	28.60
6	ICCV-231145	Semi-erect	48.47	29.60
7	ICCV-231137	Semi-erect	45.27	27.60
8	ICCV-231127	Semi-erect	43.93	28.93
9	ICCV-231143	Erect	50.80	33.40
10	ICCV-231125	Erect	51.87	32.13
11	ICCV-231139	Erect	55.07	34.27
12	ICCV-231128	Semi-erect	53.20	33.60
13	ICCV-231133	Semi-erect	49.53	37.07
14	ICCV-231138	Erect	51.60	34.13
15	ICCV-231129	Erect	54.00	31.87
16	ICCV-231109	Semi-erect	49.73	29.47
17	ICCV-231108	Erect	49.40	29.53
18	ICCV-231131	Semi-erect	51.00	35.27
19	ICCV-130039	Erect	46.07	26.00
20	KCDE-209	Erect	66.67	44.73
21	NBeG-1267 (MH check)	Semi-erect	60.40	38.60
22	Phule Vikram	Semi-erect	60.20	43.20
23	GBM-2	Erect	60.00	33.60
24	NBeG-47	Erect	61.07	41.47
25	GJG-1913	Erect	52.73	31.27

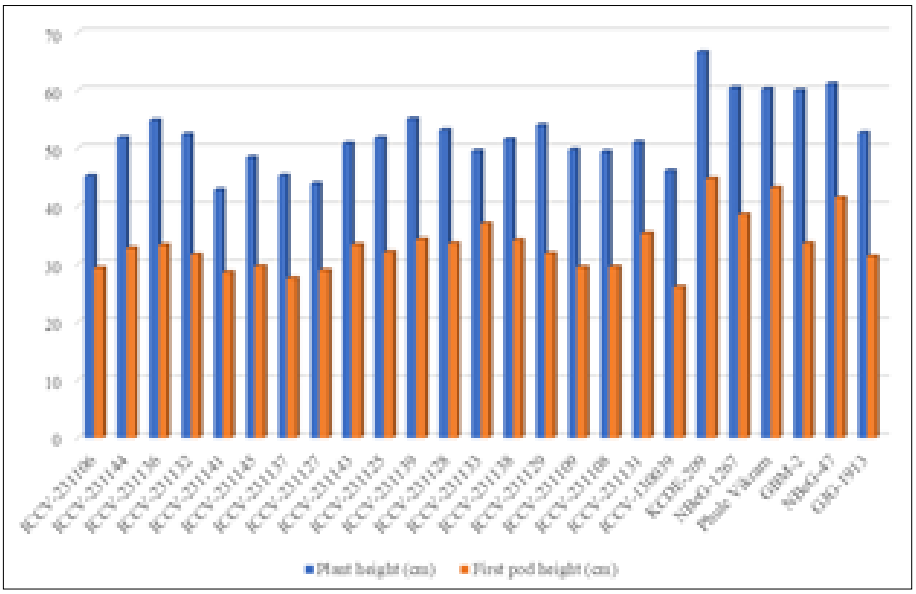


Fig 1: Mean plant height and first pod height of chickpea genotypes evaluated for mechanical harvesting

Conclusion

Based on plant height, first pod height and growth habit, KCDE-209 was identified as the most promising genotype for further evaluation for mechanical harvesting, recording 66.67 cm plant height and 44.73 cm first pod height. NBeG-1267, Phule Vikram and NBeG-47 also expressed desirable values for these traits. Among the advanced breeding lines, ICCV-231139, ICCV-231136, ICCV-231128, ICCV-231131 and several other genotypes exceeded the preliminary thresholds of 50 cm plant height and 30 cm first pod height. Confirmation under direct combine harvesting, across seasons and locations, is required before making final recommendations.

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