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# Evaluation of advanced breeding lines for identification of high vigour genotypes through field emergence and yield performance in chickpea

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**Abstract**
Field emergence is a practical expression of seed vigour as it reflects the ability of seed lots to establish seedlings under actual field conditions. The present was conducted to evaluate field emergence, plant growth and yield performance of ten advanced breeding lines of chickpea during *Rabi* 2025-26 at the Zonal Agricultural Research Station, Kalaburagi, Karnataka. Significant genotypic variation was observed among the genotypes for field emergence and seed yield. Genotype BGD-103 recorded the highest field emergence (96.72 %), plant height at 30 DAS, 60 DAS and harvest (30.01 cm, 50.76 cm and 53.87 cm respectively), test weight (30.07 g), seed yield per plot (0.84 kg) and seed yield per hectare (17.54 q $ha^{-1}$). ICCV-231104 and KCD-134 also recorded relatively high field emergence and yield. Days to 50 per cent flowering did not differ significantly, whereas days to maturity varied significantly. The genotype BGD-103 took less number of days (94.67 days) to mature. The results demonstrated substantial genetic variation for field establishment and productivity among the evaluated breeding lines and indicated that, field emergence together with growth and yield attributes can be used for preliminary identification of high vigour chickpea genotypes.

**Keywords:** Crop establishment, genetic variation, grain yield, seed size, seed quality, seedling emergence, vigour

## Introduction
Chickpea (*Cicer arietinum* L.) is an important grain legume cultivated extensively in semi-arid and rainfed environments and is predominantly grown during the *Rabi* season in India. India is the leading producer of chickpea globally and improving crop establishment, seed quality and genotype adaptation remains important for enhancing productivity. Successful establishment depends not only on the germination capacity of seed but also on its ability to germinate rapidly, produce vigorous seedlings and establish a uniform crop stand under variable field conditions. Seed vigour therefore provides information beyond standard germination and is particularly relevant for predicting seed performance under less favourable environmental conditions.

Field emergence is a practical expression of seed vigour as it integrates seed physiological potential with soil and environmental conditions prevailing during crop establishment. Genotypic differences in field emergence, early plant growth and yield have been reported in chickpea, indicating substantial variability that can be exploited in breeding and seed quality evaluation. Parameshwarudu *et al*. (2021) [6] observed significant variation among chickpea genotypes for field emergence and yield traits, while Dileep *et al*. (2024) and Naresh *et al*. (2024) [1, 4] also reported considerable genotypic variation in field establishment and yield performance. Similarly, Kumar *et al*. (2024a) [3] documented wide variation in early establishment, plant vigour and grain yield among chickpea germplasm lines. These findings indicate that, field emergence combined with subsequent crop performance can provide useful information for identifying breeding lines with desirable establishment potential.

Seed size is another important physical characteristic associated with early seedling performance as seed reserves can influence the initial growth and establishment of seedlings. Sozen and Karadavut (2024) [7] reported substantial variation in 100 seed weight and yield among chickpea varieties, whereas Yadav *et al*. (2024) [12] observed positive associations of seed yield with plant height, pods per plant and 100 seed weight. Villalobos *et al*. (2025) [10] further demonstrated that, seed mass influenced field emergence, vegetative growth and seed yield, with heavier seed groups exhibiting greater emergence and subsequent productivity. Thus, evaluation of seed size together with field establishment and yield traits can provide a more comprehensive basis for characterizing variation in seed performance.

Despite the availability of conventional seed quality tests, field emergence remains important for determining whether differences observed among seed lots or genotypes are expressed under actual crop growing conditions. Integrating field emergence with plant growth, yield and seed size traits can therefore help distinguish breeding lines that combine good establishment with desirable agronomic performance. Such information is relevant to chickpea breeding and seed quality evaluation, particularly for developing planting materials capable of establishing uniform stands under variable semi-arid and rainfed production environments.

The present study was undertaken to identify high vigour advanced breeding lines of chickpea based on field emergence, plant growth and yield performance under field conditions among the breeding lines.

## Material and Methods

### Study area

The field experiment was conducted at the Zonal Agricultural Research Station, Kalaburagi, Karnataka, India, during *Rabi* 2025-26. The station is situated in the North Eastern Dry Zone of Karnataka at approximately 17°36′ N latitude and 76°81′ E longitude, at an altitude of 488 m above sea level. The region has a semi-arid climate with an average annual rainfall of about 730 mm. The experimental soil was a medium black Vertisol with clayey texture, containing 23.5 per cent sand, 20.63 per cent silt and 55.87 per cent clay, with a bulk density of 1.45 g cm $^{-3}$. The soil was slightly alkaline (pH 8.06), with electrical conductivity of 0.52 dS m $^{-1}$, low organic carbon (0.52 %), medium available nitrogen (227 kg ha $^{-1}$) and phosphorus (48 kg ha $^{-1}$) and high available potassium (374 kg ha $^{-1}$).

### Plant material and experimental design

Ten advanced breeding lines of chickpea, namely ICCV-231127, SA-1, A-1, ICCV-191159, JG-11, KCD-11, ICCV-191156, KCD-134, BGD-103 and ICCV-231104, were evaluated. Seeds were obtained from the Zonal Agricultural Research Station, Kalaburagi. The experiment was laid out in a randomized block design with three replications. Each genotype occupied a plot size of 4.0 m × 1.2 m. One seed was dibbled at a depth of 5 cm, with 30 cm row spacing and 10 cm spacing between plants.

### Crop management

A basal fertilizer dose of 20:40:20 kg N:$P_2O_5$:$K_2O$ per hectare was applied through urea, diammonium phosphate and muriate of potash. Manual weeding was carried out at 25 and 45 days after sowing. Irrigation was supplied as required, with particular attention to branching, flowering and pod filling stages. At maturity, border plants were removed and the net plot crop was harvested separately. Seeds were threshed, cleaned and dried under shade to approximately 9 per cent moisture before recording yield.

### Observations recorded

Field emergence was recorded at 15 days after sowing and expressed as the percentage of emerged seedlings relative to the number of seeds planted. Plant height was measured from the soil surface to the tip of the main stem at 30 DAS, 60 DAS and harvest using five representative plants per plot. Days to 50 per cent flowering was recorded from sowing until 50 % of the plants had flowered. Days to maturity was recorded when approximately 90 % of pods in a plot had turned brown and dry. Test weight was determined from 100 randomly selected seeds. Seed yield per plot was obtained after threshing and drying the harvested plot produce, while seed yield per hectare was calculated from net plot yield.

### Statistical analysis

The experimental data was analysed using the statistical procedures described by Panse and Sukhatme (1985) [5]. Significance of genotype effects was tested using the F-test. For significant effects, critical difference values were calculated at the 5 per cent probability level for comparison of treatment means.

## Results and Discussion

The results of field emergence differed significantly among the ten advanced chickpea genotypes, indicating the existence of considerable genetic variation in seed vigour under field conditions (Table 1). Among the genotypes evaluated, BGD-103 ($G_9$) recorded the highest field emergence (96.72 %), which was statistically on par with ICCV-231104 ($G_{10}$) and KCD-134 ($G_8$) which recorded 95.97 per cent and 90.21 per cent respectively. Whereas, the lowest emergence percentage was recorded by genotype ICCV-231127 ($G_1$) (82.08 %). The higher field emergence observed in the medium seeded genotypes BGD-103, ICCV-231104 and KCD-134 compared with the very small seeded genotype ICCV-231127 suggests that, seed size might have contributed positively to seedling establishment under field conditions. Medium sized seeds generally possess greater food reserves that may support rapid reserve mobilization, early root and shoot growth and better establishment under field conditions. On the other hand, lower emergence in genotype ICCV-231127 suggests comparatively lower physiological vigour, possibly due to slower reserve mobilization, reduced membrane stability or poor tolerance to environmental stresses encountered during germination.

Plant height varied significantly at 30 DAS, 60 DAS and harvest (Table 1). The genotype BGD-103 ($G_9$) recorded the highest plant height at 30 DAS, 60 DAS and harvest (30.01, 50.76 and 53.87 cm, respectively). Whereas, the lowest plant height at 30 DAS, 60 DAS and harvest (22.26 cm, 32.62 cm and 38.62 cm, respectively) was recorded in the genotype ICCV-231127 ($G_1$). Medium sized seeds contain greater carbohydrate, protein and mineral reserves, which support rapid germination, enhanced root development and vigorous early seedling growth. The increased reserve mobilization may result in improved nutrient uptake, greater leaf area development, higher photosynthetic efficiency and continuous biomass accumulation, ultimately producing taller plants throughout the crop growth period. The progressive increase in plant height from early growth to harvest was expected may be due to continuous cell division, internodal elongation and accumulation of photosynthates throughout crop development. In contrast, very small seeds possess comparatively lower reserve materials, resulting in slower seedling establishment and comparatively reduced plant height. Similar genotypic variation in growth and field establishment has been reported in chickpea by Dileep *et al*. (2024), Naresh *et al*. (2024) [1, 4] and Vignesh *et al*. (2024) [9].

**Table 1:** Field emergence and plant height of chickpea advanced breeding lines.

| Genotype | Field emergence (%) | Plant height (cm) | | |
|---|---|---|---|---|
| | | 30 DAS | 60 DAS | Harvest |
| G1: ICCV-231127 | 82.08 | 22.26 | 32.62 | 38.62 |
| G2: SA-1 | 82.50 | 23.01 | 37.20 | 39.90 |
| G3: A-1 | 84.38 | 23.41 | 38.86 | 40.99 |
| G4: ICCV-191159 | 84.59 | 23.64 | 38.95 | 43.10 |
| G5: JG-11 | 85.21 | 24.23 | 39.95 | 43.39 |
| G6: KCD-11 | 84.92 | 23.81 | 38.96 | 41.34 |
| G7: ICCV-191156 | 85.63 | 25.39 | 40.27 | 41.43 |
| G8: KCD-134 | 90.21 | 26.37 | 40.75 | 43.63 |
| G9: BGD-103 | 96.72 | 30.01 | 50.76 | 53.87 |
| G10: ICCV-231104 | 95.97 | 29.64 | 43.51 | 46.78 |
| Mean | 87.22 | 25.17 | 40.18 | 43.30 |
| S.Em. ± | 3.25 | 0.96 | 1.20 | 1.56 |
| CD at 5 % | 9.65 | 2.84 | 3.57 | 4.63 |

DAS = Days after Sowing.

The data on days to 50 per cent flowering revealed that, there was no significant differences among the chickpea

genotypes and data is depicted in Table 2. However, the genotypes *viz*., KCD-134 ($G_8$), BGD-103 ($G_9$) and ICCV-231104 ($G_{10}$) showed earliness in flowering and took same number of days for 50 per cent flowering (39.65 days). Whereas, the genotype ICCV-231127 ($G_1$) required the maximum number of days to attain 50 per cent flowering (43.99 days). The absence of significant variation indicates that, flowering behaviour among the evaluated genotypes was predominantly governed by their genetic background and the relatively uniform environmental conditions during crop growth rather than by seed vigour alone. Similarly, Sureddy *et al*. (2024) [8], evaluated 280 chickpea accessions and reported substantial variability for days to 50 per cent flowering (41-78 days), while emphasizing that, flowering behaviour is primarily under genetic control and that early flowering genotypes are advantageous for improving productivity. Likewise similar results were found in chickpea by Manchikatla *et al*. (2021) and Vignesh *et al*. (2024) [9]

**Table 2:** Flowering and maturity duration of chickpea advanced breeding lines.

| Genotype | Days to 50% flowering | Days to maturity |
|---|---|---|
| G1: ICCV-231127 | 43.99 | 98.33 |
| G2: SA-1 | 43.65 | 98.00 |
| G3: A-1 | 43.32 | 97.67 |
| G4: ICCV-191159 | 41.32 | 97.33 |
| G5: JG-11 | 41.32 | 96.33 |
| G6: KCD-11 | 41.32 | 97.00 |
| G7: ICCV-191156 | 40.65 | 96.00 |
| G8: KCD-134 | 39.65 | 95.67 |
| G9: BGD-103 | 39.65 | 94.67 |
| G10: ICCV-231104 | 39.65 | 95.33 |
| Mean | 41.45 | 96.63 |
| S.Em. ± | 1.21 | 0.51 |
| CD at 5 % | NS | 1.508 |

The data on days to maturity revealed significant differences among the chickpea genotypes, indicating the existence of considerable genetic variability for maturity duration (Table 2). Among the genotypes, BGD-103 ($G_9$) matured early (94.67 days) and it was on par with ICCV-231104 ($G_{10}$), KCD-134 ($G_8$) and ICCV-191156 ($G_7$) which exhibited 95.33 days, 95.67 days and 96.00 days respectively. The genotypes BGD-103, ICCV-231104, KCD-134 and ICCV-191156 all of which belongs to medium to small seeded genotypes, matured earlier than the remaining genotypes, might be due to rapid translocation of assimilates and efficient completion of reproductive development. Conversely, ICCV-231127 a very small seeded genotype exhibited relatively longer crop duration, allowing an extended vegetative and reproductive growth period that may delay the maturity under favourable environmental condition. Variation in maturity duration among chickpea breeding lines has also been reported by Dileep *et al*. (2024) [1] and Lokesh *et al*. (2025).

Among the evaluated genotypes, BGD-103 ($G_9$) recorded the highest test weight (30.07 g). The genotype ICCV-231104 ($G_{10}$) was on par with BGD-103 with the test weight of 28.29 g. The lowest test weight was recorded in ICCV-231127 ($G_8$) which recorded 17.08 g. Test weight is an important indicator of seed quality and the seeds with higher test weight BGD-103 and ICCV-231104 categorized as medium seeded genotypes. This superiority may be attributed to the greater quantity of stored carbohydrates, proteins and lipids present in medium sized seeds, which may provide sufficient energy for rapid germination, vigorous seedling establishment and enhanced root and shoot growth. Improved early vigour increases the efficiency of nutrient and water uptake, promotes greater leaf area development and photosynthetic activity and ultimately enhances dry matter accumulation. The lowest test weight was recorded in ICCV-231127 which belonged to the very small seed size category which possess comparatively lower reserve food materials, which may restrict early growth and reduce crop productivity. Sozen and Karadavut (2024) [7] and Joshi and Vandemark (2025) also reported significant variation in 100 seed weight among chickpea genotypes.

Among the genotypes evaluated, BGD-103 ($G_9$) recorded the highest seed yield per plot (0.84 kg) and seed yield per hectare (17.54 q) which was on par with ICCV-231104 ($G_{10}$) and KCD-134 ($G_8$) with the seed yield of 0.80 kg, 16.59 q, 0.73 kg and 15.11 q respectively. The lowest seed yield per plot and seed yield per hectare (0.49 kg and 10.13 q respectively) was noticed in genotype ICCV-231127 ($G_1$). The superior seed yield per plot and seed yield per hectare was observed in BGD-103, ICCV-231104 and KCD-134 can be attributed to their medium seed size as larger sized seeds possess greater food reserves, which may support rapid seedling establishment, vigorous root development, improved canopy growth and enhanced dry matter accumulation. These advantages may increase the photosynthetic capacity of plants and ultimately contribute to higher yield under field conditions. This pattern is consistent with reports that early establishment, vegetative growth and seed size can contribute to differences in chickpea productivity (Walia *et al*. 2020, Yadav *et al*. 2024, Villalobos *et al*. 2025) [10, 11, 12].

**Table 3.** Test weight and seed yield of chickpea advanced breeding lines.

| Genotype | Test weight (g) | Seed yield per plot (kg) | Seed yield per hectare (q) |
|---|---|---|---|
| G1: ICCV-231127 | 17.08 | 0.49 | 10.13 |
| G2: SA-1 | 18.67 | 0.51 | 10.58 |
| G3: A-1 | 19.89 | 0.55 | 11.48 |
| G4: ICCV-191159 | 20.98 | 0.61 | 12.70 |
| G5: JG-11 | 23.00 | 0.67 | 14.03 |
| G6: KCD-11 | 21.74 | 0.61 | 12.68 |
| G7: ICCV-191156 | 23.97 | 0.68 | 14.14 |
| G8: KCD-134 | 26.24 | 0.73 | 15.11 |
| G9: BGD-103 | 30.07 | 0.84 | 17.54 |
| G10: ICCV-231104 | 28.29 | 0.80 | 16.59 |
| Mean | 22.99 | 0.65 | 13.50 |
| S.Em. ± | 1.19 | 0.05 | 1.02 |
| CD at 5 % | 3.54 | 0.15 | 3.059 |

## Conclusions

The field evaluation demonstrated substantial genotypic variation in field emergence, plant growth, maturity, test weight and seed yield among the ten advanced breeding lines of chickpea. The genotype BGD-103 recorded the highest, while ICCV-231104 and KCD-134 were on par with BGD-103. Days to 50 per cent flowering did not differ significantly, whereas maturity duration varied significantly. The combined field performance indicates that, field emergence, growth and yield attributes can be used together for preliminary identification of high vigour breeding lines.

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