

DBGC 3 – A promising genotype of desi chickpea for north east plain of India

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Chickpea (Cicer arietinum L.) is an important crop in semi-arid regions, constituting an important component of low input agriculture in India. Since independence, the area and productivity of this crop has substantially increased. However, there has been substantial shift in area from north to south zones. This shift has been ascribed largely to the competition of chickpea with high-yielding cereal crops and emergence of other root diseases aside from Fusarium wilt. As a result, both area and productivity of chickpea have gone down in the north east plains. This requires sustainable breeding efforts to develop high-yielding chickpea genotypes with inbuilt resistance to major root diseases for cultivation in the north east plains. The development of 'DBGC 3' is a step forward in this direction.

Keywords: Chickpea, DBGC 3, North east plains, Root diseases

CHICKPEA is the most important grain legume of India. It is an important source of dietary protein particularly for vegetarians. Besides being rich in protein (20-22%), chickpea seeds are also rich in dietary fibres, minerals (phosphorus, calcium, magnesium, zinc and iron), β -carotene and unsaturated fatty acids. It also plays an important role in enriching soil fertility by fixing atmospheric nitrogen as much as 180 kg/ha. Besides, it also adds substantial amount of organic matter to the soil.

In India, chickpea is grown on an area of around 10 Mha with the production of over 11.91 MTs and with a productivity of 1.2 t/ha, respectively. The central zone (Madhya Pradesh, Maharashtra, Gujarat, Chhattisgarh and major portion of Rajasthan) and south zone (Karnataka, Telangana, Andhra Pradesh and Tamil Nadu) accounts for over 80% of the total area and production. In the north east plain zone (eastern Uttar Pradesh, Bihar, Jharkhand, Assam and West Bengal) too, it is grown on sizeable area (1.2 Mha). In this zone, mostly *desi*

type chickpea is grown during *rabi* season.

In the last two decades, chickpea area in the north east plain zone (NEPZ) has drastically come down due to various reasons including replacement of chickpea by wheat and other remunerative high value crops, prevalence of *Fusarium*

wilt, and emergence of dry root rot and collar rot diseases. These production constraints have also adversely affected the regional productivity. These constraints call for undertaking systematic breeding efforts to develop high-yielding varieties with built-in resistance to such root diseases. The development



Field view of DBGC 3 at harvesting stage

Table 1. Descriptive features of 'DBGC 3'

Characteristic	DBGC 3
Stem : Anthocyanin colouration	Present
Days to flowering (50%)	77 days
Plant : Growth habit	Semi-erect
Plant : Colour of foliage	Dark green
Deposition on leaf surface	Waxy-like deposition on the exterior leaf surface
Leaflet : Size	Medium (10-15 mm)
Leaflet : Pattern	Compound
Flower: Number per peduncle	Double to single (variable expressivity on the same plant)
Flower: Colour	Pink
Plant : Height	Medium (59.5 cm)
Plant : Days to maturity	129 days
Pod : Size	Medium
Seed: Colour	Brownish grey
Seed : Size (weight of 100 seeds)	21.27 g
Seed : Shape	Angular
Seed : Testa texture	Rough
Seed: Ribbing	Absent
Seed : Type	Desi

of 'DBGC 3' is an endeavor towards this direction.

Development of 'DBGC 3'

The genotype 'DBGC 3' has been derived from a cross between 'ICC 13124' and 'WR 315' following pedigree method of advancement of segregating generations. The genotype 'ICC 13124' has been reported promising for drought tolerance, earliness, large seed size and high yield per plant. The genotype 'WR 315' is resistant to chickpea wilt. It has been shown that single genes in 'WR 315' governs resistance to each of the five

racess (1A, 2, 3, 4, and 5) of the causal organism (*Fusarium oxysporum* fsp *ciceris*). Resistance to race 2 in WR 315 is governed by a single recessive gene. The line 'DBGC 3' was finally selected in F₆ generation based on several distinguishing morphological characters (Table 1). It was put to preliminary yield trial during 2017-18. Based on its performance, it was evaluated in station trials consecutively for two years (2018-19 and 2019-20). Based on its yield advantage over the check variety 'BG 3043', the entry was evaluated in AICRP trials for further assessment.

Table 2. Mean yield and other important attributes of 'DBGC 3' vis-à-vis check varieties of chickpea evaluated in north east plain zone

Character	DBGC 3	PBG 9 (GL13001)	BG 3043	GNG 2207	GCP 105	KPG 59
Days to 50% flowering	77	78	76	80	79	80
Days to maturity	129	129	127	130	130	131
100 seed wt (g)	21.27	21.56	19.61	16.34	18.16	19.26
Grain yield (kg/ha)	1750	1379	1546	1492	1508	1598
Overall yield advantage of 'DBGC 3' over checks	26.90		13.20	17.29	16.05	9.51
Pod/plant (no.)	72.5	--	73.5	--	--	--
Plant height (cm)	59.5	--	54.5	--	--	--
Protein content (%)	20.86	--	19.16	20.13	20.13	21.00
Zn content (ppm)	46.25	--	35.67	23.8	36.25	37.1
Fe content (ppm)	53.60	--	54.5	65.1	53.55	53.8

Performance of 'DBGC 3' in AICRP trials

The test genotype 'DBGC 3' was tested along with five check varieties consecutively for three years (2020-21, 2021-22 and 2022-23) over 20 locations spread over NEPZ. However, yield data of only 15 locations were accepted as reported in the Annual Reports (2020-21, 2021-22 and 2022-23) of AICRP (Chickpea). The test genotype 'DBGC 3' showed an overall yield advantage of 26.9% over 'PBG 9' (a *desi* chickpea variety released in 2021 for NEPZ) (Table 2). Its yield superiority was also 13.20 and 17.29%, respectively over 'BG 3043' and 'GNG 2207' (ruling varieties of chickpea in NEPZ). Its mean days to 50% flowering (77 days) and maturity duration (129 days) are matching with the check variety 'BG 3043'. For the remaining checks, it showed some advantage for average days to 50% flowering and days to maturity. It has an excellent grain colour, size and shape, and is likely to fetch consumers' preference in the NEPZ. Its average 100-seed weight is 21.27 g. Protein, Zn and Fe contents of the 'DBGC 3' are comparable with check varieties.

Grain yield is weighted mean over 15 locations recorded during 2020-21 to 2022-23; days to flowering, maturity and 100-seed wt represents weighted mean over 20 locations recorded during the same period; pod/plant and plant height represent the mean of station trials conducted during 2018-19 and 2019-20 at ICAR RCER, Patna; protein content is the mean value analyzed at IIPR,



Single plant of 'DBGC 3'

Table 3. Reaction of 'DBGC 3' to chickpea wilt disease at wilt-sick nursery, TCA, Dholi (*rabi* 2017-18 to 2022-23)*

Test genotype/ check	2022-23 % mean Reaction wilting		2021-22 % mean Reaction wilting		2020-21 %mean Reaction wilting		2018-19 %mean Reaction wilting		2017-18 %mean Reaction wilting	
DBGC 3	5.76	R	12.91	MR	11.58	MR	13.76	MR	3.97	R
Resistant check (Pusa 256)	NR	NR	NR	NR	NR	NR	9.36	R	NR	NR
Susceptible check (JG 62)	73.33	HS	85.48	HS	86.25	HS	80.91	HS	69.55	HS
LSI (%)	NR		NR		NR		NR		NR	

NR: not reported by the pathologist; R: resistant; MR: moderately resistant; HS: highly susceptible



Seeds of 'DBGC 3'

Kanpur and FSRCHPR, Ranchi; Zn & Fe is mean value analyzed at IIPR, Kanpur and ICAR RCER, Patna.

Disease reaction of 'DBGC 3' in sick plots

The wilt reaction of the breeding line 'DBGC 3' was assessed for five years at Tirhut College of Agriculture, Dholi (under RPCAU, Pusa). The genotype exhibited consistent reaction (resistant to moderately resistant) to *Fusarium* wilt in wilt-sick plots during 2017-18, 2018-19, 2020-21, 2021-22 and 2022-23. The reaction of susceptible check (JG 62) was rated highly susceptible, indicating the inoculum load in the wilt-sick plots (Table 3). Besides, it was also tested in AICRP pathological trials for assessing its reaction against other root diseases. It showed moderately resistant reaction to dry root rot (2022-23 and 2021-22) and collar rot (2022-23) at Sabour and Shillongani, respectively (data not presented).

Insect pest reaction of 'DBGC 3'

Gram pod borer (*Helicoverpa armigera*) is the most damaging insect pest of chickpea. The insect larvae feed on the foliage, flowers and pods of the chickpea plant, sometimes causing severe damages. Though pod borer can be controlled effectively through application of insecticides, incorporation of host plant resistance is considered an eco-friendly approach. Therefore, response of 'DBGC 3' towards pod borer was also assessed in AICRP trials. Its reaction (based on larval population and per cent pod damage) to pod borer was comparable to the local check (BG 3043) during 2022-

23. At Dholi, this genotype showed matching performance with the resistant check (ICCL 86111) for per cent pod damage during 2021-22 and 2022-23. Besides, 'DBGC 3' showed yield advantage of over 39 and 12% respectively during 2021-22 and 2022-23 at Dholi centre when trials were managed under natural condition.

Package of practices

For realizing maximum yield potential of 'DBGC 3', the genotype

needs to be grown under timely sown irrigated condition. In the NEPZ, timely sowing starts from the second week of November. Sowing after the 4th week of November drastically reduces the grain yield as the pod-filling stage coincides heat stress. First irrigation should be provided at maximum branching stage (5-6 weeks after sowing). If sufficient moisture exists at podding stage, irrigation needs to be avoided. The details of package and practices are given in Table 4.

Table 4. Package of practices for 'DBGC 3'

Attribute	Detail
Sustainability of the genotype for the area	It is slightly early, and could be an ideal variety for bringing about sustainable crop intensification post-rice cultivation in rice fallow cropping systems of eastern Indian states
Selection of field/land preparation	Well drained sandy loam/loam soils; one harrowing followed by two ploughing
Seed treatment	Seed treatment with Vitavax (1g/kg seed)/ <i>Trichoderma</i> (6-8g/kg seed) and <i>Rhizobium</i> (200 g/10 kg seed)
Sowing time	Second to third week of November for realizing its maximum yield potential
Seed rate/sowing method-line sowing with row-to-row & plant-to-plant distance	Seed rate: 75 kg/ha; sowing with seed drill at 8-10 cm depth; Spacing: 30 cm (row-to-row) × 10 cm (plant-to-plant within the row)
Fertilizer doses	20 kg N + 40 kg P ₂ O ₅ + 20 kg S + 25 kg ZnSO ₄ /ha; FYM: 5-10 t/ha
Weed control	Pre-emergence herbicide application of Pendimethalin @ 0.75-1.0 kg ai/ha followed by hand weeding at 25-30 and 55-60 days after sowing
Disease and pest control	Disease: Seed treatment with fungicides Pest control: Indoxacarb @400 mL/ha; Spinosad @ 200 mL/ha
Irrigation	One at pre-flowering and one at pod development as per need
Harvesting	Harvested when crop turns completely yellow-brown and plants start senescence
Quality characteristics of the variety, if any	Attractive grain colour, optimum grain size and shape
Attainable yield (t/ha)	Average yield: 1.8-2.0 t/ha (with a potential of 2.8 t/ha)

SUMMARY

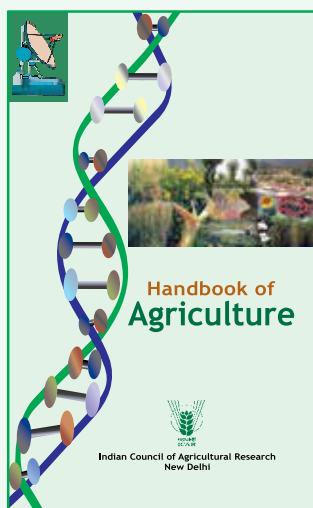
The advance breeding line 'DBGC 3' is high-yielding with several unique characteristics including double flower per peduncle and presence of waxy-like substances on the exterior surface of leaves. It is management responsive with a yield potential of 2.8 t/ha. It is resistant/moderately resistant to root diseases such as wilt, dry root rot (MR reaction at BAU, Sabour during 2021-22 and 2022-23) and

collar rot (MR reaction at Shillongani during 2022-23). It has also shown moderate resistance to Botrytis grey mold (at Pant Nagar during 2021-22) and chickpea stunt (at BAU, Sabour during the year 2022-23). It has also exhibited tolerance to gram pod borer. Its grain colour is highly attractive. Seeds are medium large, and of good shape. Seeds have high protein and zinc content. Considering these desirable agronomic and quality features,

'DBGC 3' has been recommended for release in the NEPZ by the Varietal Identification Committee in its meeting held on September 01, 2023 at MPKV, Rahuri during the Annual Group Meet on *rabi* pulses. Its release and notification is likely to have impact on increasing chickpea area and productivity in the NEPZ.

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TECHNICAL SPECIFICATIONS

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