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ORIGINAL ARTICLE

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HC-6 (Haryana chana no. 6) is a new desi variety of chickpea release for timely as well as late sown condition of Haryana condition

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ABSTRACT

Chickpea, a major global pulse crop, is valued for its high protein content and is predominantly cultivated under rain-fed conditions, yielding an average of 1 tonne/ha, well below its 6 tonnes/ha potential under optimal conditions. Environmental stressors such as heat, cold, drought, and salinity significantly limit productivity. To bridge this yield gap, the HC 6 chickpea variety was released in 2022, designed for cultivation in Haryana, India. Recommended sowing dates are from October 25 to November 20 for timely planting, and November 21 to December 10 for late sowing. HC 6 has a profuse branching, spreading plant structure, and attractive yellow-brown seeds, with a medium seed size of 17.0 g/100 seeds. It has demonstrated a yield of 26.69 q/ha and a protein content of 21.76%, showing notable tolerance to heat (>30°C) and drought. The variety, identified nationally with IC 642745, originated from an interspecific cross between two cultivated chickpea genotypes by Haryana Agricultural University, Hisar. Released for commercial cultivation in 2020, HC 6 combines traits from its female parent H 99-264, which has a semi-erect growth habit, pink flowers, and wilt resistance, with its male parent H 00-256, known for its spreading growth habit, large seeds, and resistance to wilt, collar rot, and Ascochyta blight. HC 6 has shown a yield increase of 34.12% over the check variety HC 1 (19.90 q/ha) and maintains a high level of wilt resistance at 8.3%.

KEYWORDS

Chickpea; New variety; Timely sown; Late sown; Haryana

ARTICLE HISTORY

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Introduction

Chickpea serves as a crucial source of affordable protein for low-income consumers globally, especially in developing nations where access to animal-based protein is limited for much of the population. The global reliance on a small range of low-nutritional-value crops has contributed to an unbalanced diet and increased food insecurity, with the World Health Organization (WHO) reporting that approximately 9.9% of the world's population is undernourished—a figure that may rise by 2030 [1]. Pulses, rich in protein, carbohydrates, vitamins, and minerals (e.g., folate, iron, calcium, magnesium, zinc, and potassium), are highly valued for their fiber content and low fat, earning them the label "protein for the poor" worldwide. In India, Rabi pulses occupy 50% of the total area under pulses (13.6 million ha), contributing about 64% to production (15.7 million tonnes). Among these, chickpea is the predominant Rabi pulse, comprising approximately 47% of the country's pulse production. It is a self-pollinated legume crop containing 17-24% protein and 41-50.8% carbohydrates, alongside a significant content of minerals and other essential nutrients, making it a major pulse for human consumption [2].

Chickpea offers a balanced nutritional profile, delivering energy, protein, fiber, and essential vitamins and minerals, and contains health-promoting phytochemicals (Figure 1). It includes all essential amino acids, except sulfur-containing amino acids, which can be complemented by cereals in a balanced diet. In 2011-2012, the average per capita pulse consumption was 27 grams per day, well below the recommended intake of 80-97 grams. Although pulse consumption has increased over time, chickpea remains an economical and nutritionally beneficial food source in developing countries. However, challenges such as low productivity, erratic rainfall, pest and disease outbreaks, lack of quality seeds, limited market infrastructure, and lower minimum support prices compared to cereals have restricted chickpea production in India [3,4].

Figure 1. Chickpeas

Chickpeas thrive on conserved soil moisture, making them resilient to climate variability, and their heterozygosity contributes to environmental adaptability. As nitrogen-fixers, chickpeas contribute up to 140 kg of nitrogen per hectare annually, with

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around 70% of nitrogen supplied through symbiotic N2 fixation, improving soil fertility for subsequent cereal crops (Figure 2). This nitrogen-fixing capacity allows chickpeas to be rotated with cereals, enhancing soil health through added organic matter and residual nitrogen. Additionally, the symbiotic relationship between chickpeas and rhizobia, essential for nitrogen fixation and phosphate solubilization, significantly enhances plant growth and soil quality [5,6].

Figure 2. HC 6: Single plant (at vegetative and podding stages).

During the 2023-2024 season, chickpeas were grown over an area of 9.5 million hectares, with a production of 11.58 million tonnes (AICRP Report, 2023-2024). Recognizing the need for improved varieties, HC 6, a new chickpea (*Cicer arietinum L.*) cultivar, was developed after a gap of 30 years by the Pulses Section, Department of Plant Breeding & Genetics, CCS Haryana Agricultural University, Hisar. Derived from a cross between H 99-264 and H 00-256, HC 6 was approved by the State Variety Approval [7,8].

Committee (SVAC) in June 2021 and later released by the Indian Council of Agricultural Research (ICAR) in July 2022 for commercial cultivation in Haryana. With an average seed yield of 26.00 q/ha—21.4% and 28.7% higher than HC 1 and HC 5, respectively—HC 6 shows notable resistance to wilt disease (*Fusarium oxysporum f. sp. ciceri*) at an 8.3% infection rate [9,10].

Breeding History of HC 6

The development of the chickpea variety HC 6 was led by Krishan Kumar, A.K. Chhabra, and Sunil Kumar in 2022. The breeding program began during the Rabi season of 2002-03, with a cross between the advanced breeding line H 99-264 (female parent) and H 00-256 (male parent), both derived from cultivated chickpea (*Cicer arietinum L.*) (Figure 3). The goal was to develop a variety with improved wilt resistance and higher seed yield, intended to replace the aging variety HC 1, which was released in 1990. Over the past few years, HC 1 had become susceptible to wilt and exhibited significantly lower yields, especially in chickpea-growing districts of Haryana like Hisar, Bhiwani, Siwani, and Sirsa [11].

In the Rabi season of 2003-04, the F1 seeds from the cross were grown, and all resulting F1 plants were selected. These seeds were sown in a large plot in the following season (2004-05), covering 15 rows of 4 meters in length, with spacing of 0.30m x 0.20m. In this season, desirable single plant selections were made from the F2 population [12]. This segregating population was advanced from F2 to F5 during the years 2004 to 2008. (Figure 4).

Figure 3. HC 6 Field view at Physiological maturity.

Figure 4. HC 6: Field View.

In the Preliminary Yield Trial (PYT) conducted during the 2007-08 season, further selection took place, followed by subsequent trials: Small Scale Trial (SST) in 2008-09, Large

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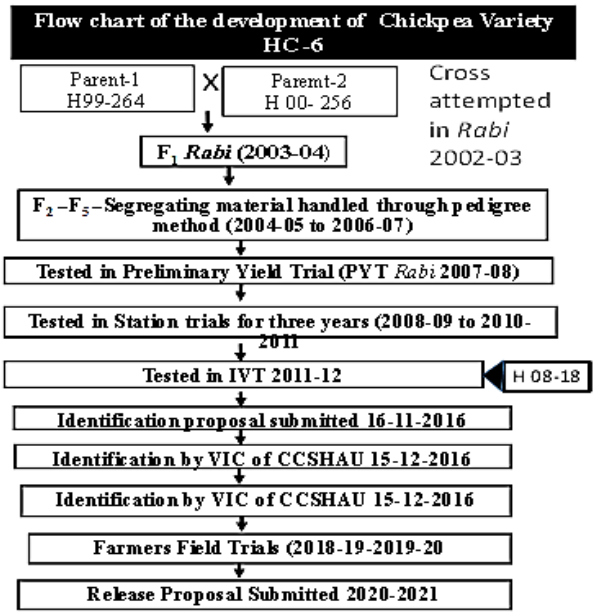
Scale Trial in 2009-2010, and Multi-Location Trials (MLT) in 2010-11. Data from the MLT in 2010-11 indicated the potential of the new entry H 08-18, which was then tested in the Initial Varietal Trial (IVT) during the 2011-12 season [13,14]. This testing was conducted across various locations in the North West Plain Zone (NWPZ), including Sri Ganganagar, Ludhiana, Hisar, New Delhi, Pantnagar, Modipuram, Srinagar, and Dhaulakuan. The development of HC 6 spanned a period of 18 years, from the initial cross to its eventual release for commercial cultivation, as illustrated in (Chart 1).



Key Agronomic and Quality Traits of Chickpea Variety HC 6

HC 6 has demonstrated robust agronomic performance, achieving an average yield of 25 quintals per hectare across nine locations. During the 2011-2012 season, HC 6 recorded the highest seed yield of 4167 kg/ha at Hisar, followed by SGNR at 3327 kg/ha. On average, HC 6 has shown a yield increase of 16.5% and 9.0% over check varieties DCP 92-3 and GNG 469, respectively (Table 1). This variety has exhibited consistent performance over a 13-year trial period at Hisar and five years at RRS, Bawal, consistently surpassing 2.5 tonnes/ha, a benchmark indicating its suitability for cultivation in Haryana (Table 2).

Table 1. Performance of HC 6 (H 08-18) against checks in Coordinated Varietal Trial (CVT-Desi) NWPZ during Rabi 2011-2012.

Station	Seed yield (kg/ha)				
	HC 6 (H 08-18)	DCP 92-3(C)	GNG 469(C)	GNG 1581(C)	CD(p=0.05)
Sriganganagar	3327	2788	2696	2872	0439
Ludhiana	2639	2778	3472	3333	0474
Durgapura	1562	2521	1805	2354	0352
Hisar	4167	3194	3750	3785	0313
New Delhi	2389	2361	2861	2472	0334
Pantnagar	1267	2100	2274	0833	0448
Modipuram	1604	1611	1875	1854	0295
Srinagar	0972	833	833	1486	0199
Dhaulakuan	1250	2570	2157	3056	0561
Mean	2516	2261	2581	2634	342
% percent increase over the checks (mean basis)		10.17	-2.52	-4.44	
At Hisar % percent increase over the checks		23.0	10.0	9.2	
At SGNR % percent increase over the checks		16.2	19.0	13.7	
Average (Mean basis +Hisar +SGNR)		16.5	8.8	6.2	

Table 2. Performance of HC 6 against checks in Station trial from 2010-2011 to 2023-2024 during Rabi season.

Sr. No.	Year	Trial	Seed yield (kg/ha)				
Rainfed conditions (Bawal)			HC 6	HC 1/HC 7 (C)	HC 5 (C)	CD (p=0.05)	CV (%)
1	2010-2011	MLT	1718	1185	1677	208	7.86
2	2013-2014	MLT	1750	1603	1523	131	5.50
3	2021-2022	MLT	2010	2158	1983	310	9.3
4	2022-2023	MLT	928	721	747	251	19.7
5	2023-2024	MLT	1881	1662	1353	395	14.6
% Increase over HC 1/7/HC 5		Average	1657	1466	1457	259	11.0
Timely Sown Irrigated conditions				11.6	13.7		

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1	2010-2011	MLT	3007	2070	2104	446	11.58
2	2011-2012	FYT	3889	2689	2639	318	7.03
3	2012-2013	FYT	3139	2375	-	433	9.85
4	2013-2014	FYT	2615	1740	1826	270	7.31
5	2013-2014	MLT	2516	1788	1903	332	9.85
6	2014-2015	FYT	1560	1012	999	180	9.58
7	2015-2016	FYT	2966	2254	2183	328	8.27
8	2016-2017	FYT	3314	2431	2329	347	7.13
9	2018-2019	FYT	2642	2302	2042	335	8.32
10	2020-2021	MLT	2536	2279	2466	426	11.4
11	2021-2022	FYT	2243	2347	2263	379	10.0
12	2022-2023	MLT	2164	2007	2128	391	10.8
13	2023-2024	FYT	1217	1284	1218	328	18.7
	Average over 13 locations		2601	2044	1854	347	10.0
	% Increase over HC 1/7/HC 5			21.4	28.7		
1	2011-2012	CVT (HSR	(HC 6)	GNG 469	GNG 1581		
			4167	3749	3785	331	6.30
	% Increase over GNG 469 and GNG 1581			11.15	10.09		

The plant structure of HC 6 is semi-erect, standing at approximately 73 cm with green foliage and a dark green stem. HC 6 flowers in 96 days and matures within 147 days, bearing an average of 68 pods per plant. It produces medium-sized, angular, ram's head-shaped brown seeds with excellent culinary properties and an average seed weight of 17.0g per 100 seeds (Table 3). This seed size, less than 20g per 100 seeds, is ideal for dal preparation, as larger seeds may break unevenly, reducing dal yield and impacting processing efficiency.

Table 3. Yield and Yield contributing traits of HC 6 as compared to HC 1 and HC 5 in station trials at Hisar.

Sr No.	Character	2010-2011			2012-2013			2018-2019			Mean of 3 years		
		HC 6	HC 1 (C)	HC 5 (C)	HC 6	HC 1 (C)	HC 5 (C)	HC 6	HC 1 (C)	HC 5 (C)	HC 6	HC 1 (C)	HC 5 (C)
1	Days to 50% Flowering	90	94	92	103	94	92	96	95	88	96	94	91
2	Days to Maturity	136	130	130	164	162	156	142	152	143	147	148	143
3	Plant height (cm)	67	49	72	68	68	84	85	93	84	73	70	80
4	Number of branches per plant	4.0	3.5	4.3	6.0	6.1	5.0	3.0	3.0	3.0	4.0	4.0	4.0
5	Number of pods per plant	48	59	49	115	104	76	41	27	40	68	63	55
6	Number of seeds per pod	1.6	1.6	1.5	1.4	1.7	1.7	-	-	-	1.5	1.7	1.6
7	100 seed-weight (g)	17.6	14.0	16.1	16.9	15.1	17.1	17.3	15.5	17.0	17.0	15.0	17.0
8	Average seed yield (kg/ha)	3007	2070	2104	3139	2375	2152	2642	2302	2042	2929	2249	2099

HC 6 is notable for its high protein content of 21.76%, the highest among the AVT 2 entries tested in the 2020-2021 North West Plain Zone trials (Table 4). It also boasts 11.33 nodules per plant, with a nodule dry weight of 22.88 mg per plant and a harvest index of 37.14%.

As chickpea cultivation faces challenges from climate change and increased prevalence of diseases like wilt and root rot, HC 6 provides a reliable solution. It is high-yielding, resistant to wilt and collar rot, and displays resistance to *Fusarium oxysporum f. sp. ciceri* with a low disease incidence of

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only 8.3% (Table 5). Furthermore, HC 6 exhibits enhanced tolerance against *Helicoverpa armigera* in comparison to HC 1 and HC 5 (Table 6).

Table 4. Data on Quality characteristics of HC 6 (H 08-18) and AVT 2 entries during 2020-2021 by Lowry's Method at IIPR, Kanpur.

Sr.No	Sample Name	Average Protein (%)
1	HC 6 (H 08-18)	21.76
2	RG 2016-134	18.74
3	NBeG 857	16.85
4	DC 2017-1111	18.95
5	IPCK 2013-163	20.96
6	GLK 17301	16.05
7	GJGK 1617	18.01
8	CSJK 174	18.43
9	PhuleG16318	17.84
10	NBeG 506	19.35

Table 5. Disease reaction to Fusarium wilt of HC 6, HC 1 and HC 5in different years at Hisar.

Year	*Fusarium* wilt (%)		
	HC 6	HC 1(Check)	HC 5(Check)
2011-2012	5.4	7.4	8.1
2012-2013	6.6	3.3	1.4
2013-2014	9.1	56.5	51.9
2014-2015	5.6	17.6	17.6
2015-2016	9.4	55.8	60.6
2016-2017	13.1	11.4	23.6
2017-2018	7.5	15.0	19.0
2018-2019	10.0	17.5	18.5
Average over the 08 Years	8.3	23.1	25.1

Disease Reaction: Fusarium Wilt: R = 0-10%; MR = 11-20%; T =21-30%; S =31-50%; HS=51-100% [Data Reaction Categories/Scale as per All India Coordinated Research Project on Chickpea
(Indian Council of Agricultural Research)]

Summary of results

The evaluation of HC 6 (H 08-18) across different trials demonstrates its promising performance in comparison to established checks (DCP 92-3, GNG 469, and GNG 1581) over several years and conditions.

Table 1. Performance of HC 6 in Coordinated Varietal Trial (CVT-Desi) NWPZ (Rabi 2011-2012)

- HC 6 outperformed checks at multiple stations, notably at Hisar with a seed yield of 4167 kg/ha (23% increase over checks).
- The average seed yield across all stations was 2516 kg/ha, showing a 10.17% increase over the check mean.

Table 2. Performance of HC 6 in Station Trials (2010-2011 to 2023-2024)

- Under rainfed conditions, HC 6 had an average yield of 1657 kg/ha, which was 11.6% higher than HC 1/HC 7.
- In timely sown irrigated conditions, HC 6 showed a significant yield advantage, averaging 2601 kg/ha, which is 21.4% higher than HC 1/HC 7.

Table 3. Yield and Yield-Contributing Traits at Hisar

- HC 6 demonstrated favorable agronomic traits, such as shorter maturity days and a higher number of pods per plant, compared to checks.
- The average seed yield over three years for HC 6 was 2929 kg/ha, indicating consistent performance.

Table 4. Quality Characteristics of HC 6

- HC 6 had the highest protein content (21.76%) compared to other entries, indicating superior nutritional quality.

Table 5. Disease Reaction to *Fusarium* Wilt

- HC 6 exhibited a significantly lower percentage of Fusarium wilt across multiple years compared to checks, showcasing better disease resistance.

Table 6. Screening of chickpea genotypes HC 6, HC 1 & HC 5 against gram pod borer (*Helicoverpaarmigera*) during Rabi 2011-12 to 2018-2019.

Year	Larval population/ mrl*						
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2018-19
H 08-18	2.9 (1.97)	38.4 (6.27)	75.6 (8.75)	7.2(2.86)	7.1 (2.85)	12.67 (3.69)	0.19 (1.63)
HC (Check)	2.9 (1.98)	21.6 (4.74)	76.1 (8.78)	8.0 (2.99)	8.6 (3.09)	14.89 (3.97)	0.33 (1.90)
HC 5(Check)	3.2 (2.05)	-	97.2 (9.91)	8.6 (3.09)	8.9 (3.14)	17.00 (4.24)	0.00 (1.00)
SEm±	(0.12)	NS	(0.15)	(0.06)	(0.06)	(0.16)	0.26
CD (p=0.05)	(0.24)	-	(0.43)	(0.17)	(0.18)	(0.47)	NS
				Per cent pod damage**			
H 08-18	4.9(12.77)	15.5(23.17)	49.8(44.87)	58.2(49.72)	16.7(24.11)	13.67 (21.34)	4.61 (12.19)
HC 1(Check)	5.3(13.14)	29.6(33.22)	46.6(43.07)	48.4(44.06)	22.4(28.25)	8.42 (16.73)	14.61 (21.57)
HC 5(Check)	9.7(17.85)	-	53.0(46.70)	41.0(39.24)	17.8(24.94)	13.65 (21.40)	8.72 (16.88)
SEm±	(1.51)	(1.45)	(1.04)	(1.25)	(0.54)	(1.64)	(1.87)
CD p=0.05)	(3.11)	(3.97)	(2.98)	(3.57)	(1.54)	(4.72)	(5.37)

*Figures in parenthesis are √(n+1) values
** Figures in parentheses are angular transformed values

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Conclusion

HC 6 (H 08-18) has shown consistent superiority in both yield and quality traits across multiple trials and environments, making it a robust candidate for cultivation. Its increased resistance to *Fusarium* wilt and high protein content further enhances its value for growers. The positive performance metrics suggest that HC 6 could significantly contribute to agricultural productivity, especially in the North Western Plains Zone.

In timely sown conditions, 22 on-farm trials (OFT) conducted during the 2018-2019 Rabi season demonstrated that HC 6 outperformed HC 5 by 10.25%, with a yield of 14.40 q/ha (Table 7). Across 12 additional OFT trials in Mahendergarh, Rewari, Rohtak, Sonepat, and Jhajjar, HC 6 achieved a mean yield of 19.55 q/ha, showing a 17.26% advantage over HC 1 (Table 7a). Similarly, in 10 trials within the same regions, HC 6 averaged 21.28 q/ha, surpassing HC 1 by 16.65% (Table 7b).

The individual trial results indicate the following:

- **Yamunanagar:** HC 6 yielded 12.40 and 13.50 q/ha, slightly higher than HC 5, which yielded 12.33 and 13.30 q/ha, resulting in increases of 0.57% and 1.56%, respectively.
- **Ambala:** Significant gains were observed with HC 6 yielding 13.50 q/ha against HC 5's 12.00 q/ha (12.50% increase), and another trial showing HC 6 at 12.00 q/ha compared to HC 5's 11.25 q/ha (6.67% increase).
- **Karnal:** HC 6 performed strongly with yields of 24.00 and 21.00 q/ha, outperforming HC 5, which yielded 20.00 and 19.25 q/ha, translating to increases of 20.00% and 9.09%.
- **Panipat:** Results varied, with HC 6 yielding 23.25 q/ha (7.00% decrease) in one trial, while another trial yielded 24.00 q/ha (4.95% decrease) compared to HC 5.
- **Kaithal:** HC 6 exhibited improved yields, with 9.50 and 9.30 q/ha against HC 5's 8.00 and 8.40 q/ha, reflecting increases of 18.75% and 10.71%, respectively.

Table 7. Mean performance of new variety HC 6 against HC 5 at Farmers' Field on farm trials (OFT) in Haryana Rabi 2018-2019 (Timely Sown).

District	No of trials	Seed yield q/ha		% Increase HC 5
		HC 6	HC 5 (C)	
Yamunanagar DDA	1	12.40	12.33	0.57
	1	13.50	13.30	1.56
Ambala DDA	1	13.50	12.00	12.50
	1	12.00	11.25	6.67
Karnal DDA	1	24.00	20.00	20.00
	1	21.00	19.25	9.09
Panipat DDA	1	23.25	25.00	-7.00
	1	24.00	25.25	-4.95
Kaithal DDA	1	09.50	08.00	18.75
	1	9.30	08.40	10.71
10 trial Average		16.25	15.48	4.97
08 trial average		14.40	13.06	10.25

Table 7a. Mean performance of HC 6 against HC 1 at farmer's field in OF conducted by CCS HAU, Hisar during Rabi 2018-2019 (Timely Sown).

Sr. No.	Farmers Name	Taluka	Distt	D.O.S.	HC 6 (q/ha)	HC 1 (q/ha)	% Increase over HC 1
1	Kalish Chand S/o ShDayanand	Bawania	M.Garh	15.11.18	22.0	19.0	15.8
2	Dalip S/o ShNaharSingh	Bawania	M.Garh	16.11.18	22.5	18.7	20.3
3	Sunil S/o Balbir	N. Shalu	M.Garh	16.11.18	22.2	19.2	15.6
4	ShGurmel S/o ShSundaram	Pranpura	Rewari	26.10.18	19.0	19.5	-2.6
5	Sh. Phool Singh S/o Sh. Ratiram	Jaitpur	Rewari	25-10-18	18.7	19.0	-1.6
6	Jaswant S/o Sh. Phool Singh	Jaipur	Rewari	25-10-18	18.5	19.0	-2.6
7	Sh. Lal Singh S/o ShSundaram	Jaitpur	Rewari	25-10-18	18.5	19.0	-2.6
8	Sh.Ramprasad S/o Sh Amar Singh	Shahpur	Rewari	26-10-18	19.0	19.2	-1.0
9	DDA Rohtak	Rohtak	Rohtak	12-11-18	20.4	15.8	29.1
10	DDA Sonepat	Sonepat	Sonepat	12-11-18	21.0	17.0	23.5
11	DDA Jhhajar	Jhajjar	Jhajjar	12-11-18	27.8	26.9	3.3
12	DDA Palwal	Palwal	Palwal	12-11-18	20.5	16.8	22.0
			Average of 12 Location		20.84	19.09	9.90
			Average of 08 Location		19.55	16.68	17.26
			Mean of 22 locations across 11 district of Haryana 2018-2019		18.8	17.4	8.5

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Summary and conclusion

The results from the 2018-2019 Rabi season OFT demonstrate that the new chickpea variety HC 6 exhibits a superior mean seed yield of 14.40 q/ha, representing a significant enhancement of 10.25% over the established variety HC 5, which had a mean yield of 13.06 q/ha. Most districts showed positive yield increases with HC 6, particularly in Ambala and Karnal, where the improvements were particularly notable. Although some trials in Panipat indicated lower yields for HC 6 compared to HC 5, the overall performance of HC 6 suggests its potential as a viable alternative for chickpea cultivation in Haryana. These findings support the introduction and adoption of HC 6 among farmers for improved crop productivity.

Results achieved (2018-2019): The trials conducted during Rabi 2018-2019 monstrated that the new chickpea variety HC 6 exhibited an average yield of 19.55 q/ha, showing a 17.26% superiority over HC 1, which had an average yield of 16.68 q/ha. Twelve trials were conducted across multiple districts, highlighting the potential of HC 6 in improving chickpea productivity in Haryana. (Table 7a).

Results achieved (2018-2019): The results from the On-Farm Trials (OFT) conducted by CCS Haryana Agricultural University (CCSHAU), Hisar, during Rabi 2018-2019 demonstrate the comparative performance of the new chickpea variety HC 6 against the established variety HC 1. Across ten locations in Mahendergarh, Rewari, Rohtak, Sonepat, and Jhajjar, HC 6 yielded an average of 21.28 q/ha, exhibiting a significant superiority of 16.65% over HC 1, which had an average yield of 18.25 q/ha, as summarized in Table 7b. Individual farmer results varied, with HC 6 outperforming HC 1 in most trials; notable exceptions included yields from Sh. Rajbir and Sh. Anil Kumar, where HC 1 surpassed HC 6. The results highlight the potential benefits of adopting HC 6, with increases observed ranging from 1.9% to 38.1% at various sites. Overall, these trials provide promising evidence of HC 6's improved performance in the region (Table 7b).

In broader evaluations, HC 6 displayed consistent performance across Haryana, achieving an 8.0% higher yield (15.0 q/ha) than HC 1 in timely sown conditions across 35 locations in 14 districts over two years (Table 8). In late sown conditions, HC 6 averaged 21.0 q/ha across 11 locations in 7 districts, outperforming HC 1 by 24.3% (Table 8).

Results achieved (2019-2020): Thirteen on-farm trials of the new chickpea variety HC 6 were conducted in the districts of Mahendargarh, Rewari, and Rohtak during the Rabi season of 2019-2020. The mean performance of HC 6 was recorded at 11.21 q/ha, indicating a 7.37% increase over HC 1, which averaged 10.49 q/ha (see Table 8).

Results achieved (2019-2020): During the Rabi season of 2019-20, three on-farm trials of the new chickpea variety HC 6 were conducted in Sirsa. The trials demonstrated that HC 6 achieved an average yield of 23.27 q/ha, which represents a 31.86% increase compared to the HC 1 variety, which recorded an average yield of 17.67 q/ha. (Table 8a).

Table 7b. Comparative performance of HC 6 against HC 1 at farmer's field on Farm trial (OFT) conducted by CCS HAU, Hisar during Rabi 2018-2019 (Late Sown).

Sr. No.	Farmers Name	Taluka	Distt	D.O.S.	HC 6 (q/ha)	HC 1 (q/ha)	% Increase over HC 1
1	Sh. Krishankumar S/o Maduram	Karota	M.Garh	20.11.18	22.5	19.0	18.4
2	Sunil S/o ShRamavtar	Bigopur	M.Garh	21.11.18	22.0	19.2	14.6
3	Om Prakash S/o ShJagdish Pal	Islampur	M.Garh	14.12.18	20.7	18.5	11.9
4	Rambir S/o ShMohar Singh	Bayal	M.garh)	15-12-18	20.2	18.7	8.0
5	ShRajbir S/o ShPritivi	Saban	Rewari	02-12-18	18.6	19.0	-2.1
6	Sh. Anil Kumar S/o ShBalwant	Kharkhari	Rewai	28-11-18	18.8	19.1	-1.6
7	DDA Rohtak	Rohtak	Rohtak	20-11-18	18.5	13.4	38.1
8	DDA Sonepat	Sonepat	Sonepat	20-11-18	19.5	16.0	21.9
9	DDA Jhhajar	Jhajjar	Jhhajar	20-11-18	27.2	26.7	1.9
10	DDA Palwal	Palwal	Palwal	20-11-18	19.7	14.5	35.9
		Average of 10 location			20.77	18.41	14.70
		Average of 08 location			**21.28**	**18.25**	**16.65**

Table 8. Mean performance of HC 6 against HC 1 at farmer's field on Farm trial (OFT) conducted by CCS HAU, Hisar during Rabi 2019-2020(Timely sown).

Sr. No.	Farmers Name	Taluka	Distt	D.O.S.	HC 6 (q/ha)	HC 1	% Increase over HC 1
1	Surender S/o ManoharLal	Narnaul	M.Garh	06.11.19	9.0	8.5	5.88
2	Bilu S/o Sajjan Singh	Bashirpur	M.Garh	08.11.19	9.2	8.4	9.52
3	Man Singh S/o Umrao Singh	Hasanpur	M.Garh	08.11.19	8.5	8.0	6.25
4	Shriram S/o Dhrampal	Rajawas	M.Garh	18.11.19	12.5	10.0	25.00
5	ShMadanLal S/o Sh Raj Singh	Khol	Rewari	14.11.19	7.5	7.0	7.41
6	Sh. Chanderparksh s/o Sh. Chiranjilal	Konsiwas	Rewari	15.11.19	7.20	7.00	2.86

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7	ShHari Mohan	Kalanaur	Rohtak	26.10.19	16.0	16.0	0.0
8	Sh. Dhrambir	Kalanaur	Rohtak	26.10.19	14.2	14.0	1.43
9	Sh. Krishan	Sampla	Rohtak	26.10.19	13.5	13.0	3.85
10	Sh. Umed Singh	Sampla	Rohtak	26.10.19	14.5	13.0	11.54
	Mean average of 13 location in 3 Districts of Haryana (2019-2020)				11.21	10.49	7.37
	Mean of 22 locations across 11 district of Haryana (2018-2019)				18.8	17.40	8.50
	35 locations in 14 Districts of Haryana (Mean of two years)				15.0	13.9	8.0

Mean Performance Summary
Mean of 13 locations in 3 districts of Haryana (2019-2020): HC 6 = 11.21 q/ha, HC 1= 10.49 q/ha (7.37% superiority)
Mean of 22 locations across 11 districts of Haryana (2018-2019): HC 6 = 18.8 q/ha, HC 1= 17.40 q/ha (8.50% superiority)
Mean of 35 locations in 14 districts of Haryana (Mean of two years): HC 6 = 15.0 q/ha, HC 1= 13.9 q/ha (8.0% superiority)

Table 8a. Comparative performance of HC 6 against HC 1 at farmer's field on Farm trial (OFT) conducted by CCS HAU, Hisar during Rabi 2019-2020 (Late Sown).

Sr. No.	Farmers Name	Taluka	Distt	D.O.S.	HC 6 (q/ha)	HC 1	% Increase over HC 1
1	Sh. Krishankumar	Kaluana	Sirsa	25.11.19	22.8	16.6	37.3
2	Sh. Lalitkumar	Kaluana	Sirsa	26.11.19	22.4	17.2	30.2
3	Sh. Krishankumar	Rupanakhurd	Sirsa	28.11.19	24.6	19.2	28.1
		Average of 3 location			23.27	17.67	31.86
		Average of 8 location			18.25	16.65	16.65
	11 locations in 07 Districts of Haryana (Mean of two years)				21.0	17.2	24.3

Conclusions

Chickpea is the world's second most significant legume, rich in proteins, carbohydrates, minerals, vitamins, dietary fiber, and essential fatty acids. Despite its nutritional value, chickpea cultivation faces major challenges, including biotic stresses such as wilt, root rot, collar rot, Ascochyta blight, and pod borer, alongside abiotic stresses like cold, drought, heat, and salinity. To address these issues, breeding efforts have focused on developing chickpea cultivars with enhanced resistance to diseases, pests, and environmental stresses while maintaining superior seed quality. The research at the Pulses Research area, CCSHAU, Hisar, has concentrated on expanding the genetic diversity of chickpea through a broader genetic base.

This effort led to the development of a new chickpea variety, HC 6, which was released in 2022 to replace the older HC 1 variety, first introduced in 1990. HC 6 has a higher average seed yield of 26.0 q/ha compared to HC 1's 22.0 q/ha, showing yield improvements of 34.12% and 31.28% under timely sown conditions compared to the checks HC 1 and HC 5, respectively, in station trials. This variety has a protein content of 21.76%, with profuse branching, a spreading plant type, attractive yellow-brown medium-sized seeds (17.0 g/100 seeds), and yields that average 2669 kg/ha under normal conditions, with a potential yield of 3889 kg/ha observed during the 2011-2012 trials.

Under timely sown conditions across 35 locations in 14 districts of Haryana (mean of two years), HC 6 achieved an average yield of 15.0 q/ha, an 8.0% increase over HC 1 (13.9 q/ha). In late sown conditions, the variety's performance averaged 21.0 q/ha across 11 locations in 7 districts, showing a 24.3% improvement over HC 1 (17.2 q/ha). The release of HC 6, with its enhanced wilt resistance and high protein content, marks a significant advancement in chickpea breeding and commercial cultivation.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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