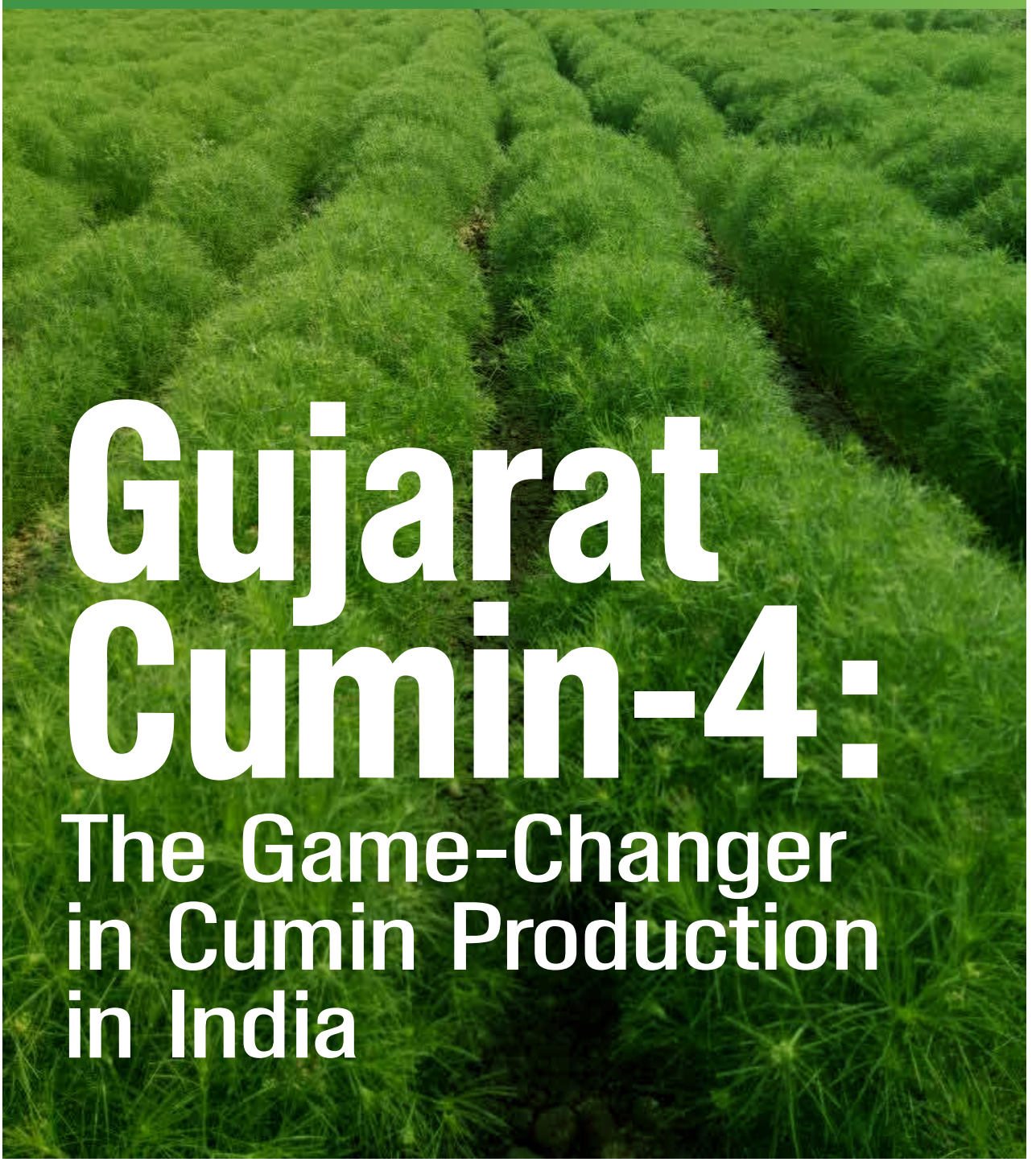
AICRPS
Technical
Bulletin
01/2023



Gujarat Cumin-4:

The Game-Changer in Cumin Production in India

Correct citation

Surbhi Chauhan, NR Patel, PJ Patel, SM Patel, Hitesh B Patel, Mukesh Sankar, Lijo Thomas and D Prasath. 2023. Gujarat Cumin 4: The Game-Changer in Cumin Production in India. AICRPS Technical Bulletin, ICAR-All India Coordinated Research project on Spices, Kozhikode, Kerala.

Publisher

Project Coordinator
ICAR-All India Coordinated Research Project on Spices
ICAR-Indian Institute of Spices Research
Kozhikode - 673 012, Kerala, India
Website: www.aicrps.res.in, E-mail: aicrps@icar.gov.in

Design

DAVnSCI.COM LLP www.davnsci.com

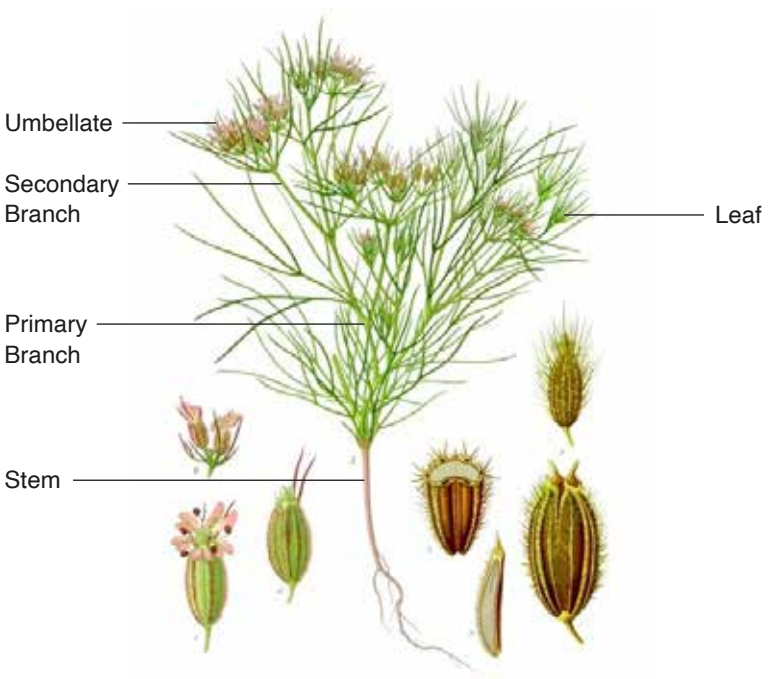
CONTENTS

Introduction

Cumin (Cuminum cyminum L.) popularly known as "*Zeera*", is one of the most important seed spice crops of India due to its domestic consumption and export earnings. It has a warm aroma due to its essential oil content. Its main aroma compounds are cuminaldehyde and cuminic alcohol. The cultivation of cumin is confined to the tropical and sub-tropical region of the world and India is one of the principal countries engaged in its cultivation. In India, the crop is grown as rabi crop in cool and dry climate. It is native to Egypt's Nile valley and the Eastern Mediterranean, it is now largely produced in India, Syria, Turkey, and the United Arab Emirates (UAE). India accounts for ~70% of the global cumin production and is a largest exporter (30-35% of its production).

Botanical description

The cumin plant is an annual herbaceous plant, with a slender, glabrous, branched stem that is 30-40 cm tall and has a diameter of 3–5 cm. Each branch has two to three sub-branches. All the branches attain the same height, so the plant has a uniform canopy. The stem is coloured grey or dark green. The leaves are 5–10 cm long, pinnate or bipinnate, with thread-like leaflets. The flowers are small, white, or pink, and borne in umbels. Each umbel has five to seven umbellets. The fruit is a lateral fusiform or ovoid achene 4–5 mm long, containing two mericarps with a single seed. Cumin seeds have eight ridges with oil canals.

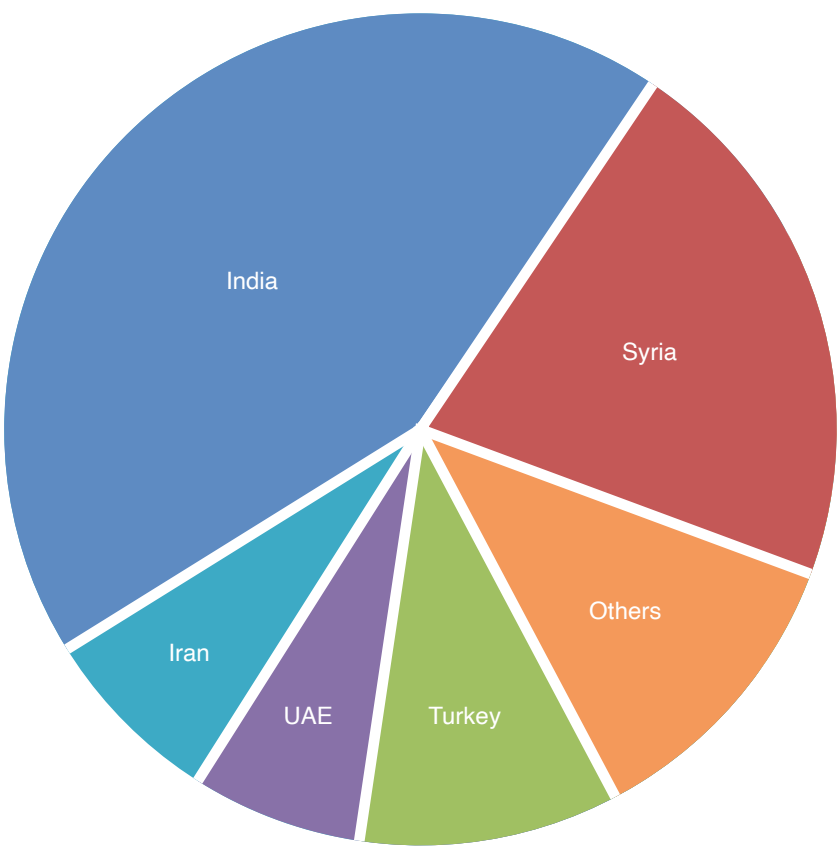


Phytoconstituents

Cumin seeds are nutritionally rich, with fat content of 14.04 g/100 g (particularly monounsaturated fat), protein (17.8 g/100 g), dietary fiber, vitamins and a few dietary minerals, iron (66.36 g/100 g). It has a particular solid flavour, because of its essential oil constituent cuminaldehyde (27.6%).

Global status

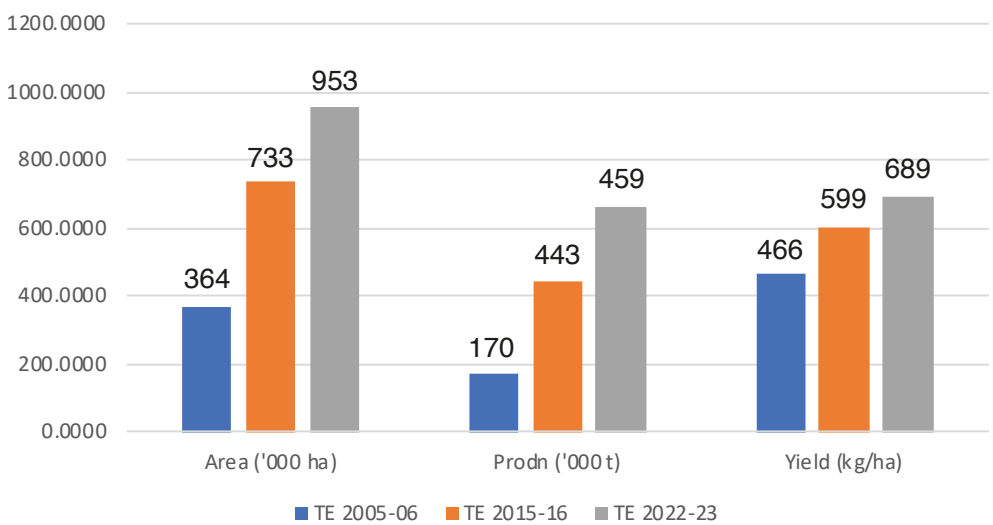
Cumin is a seed spice which finds its place in a variety of global cuisines. India has a world market share of 70%, followed by Syria (13%), Turkey (5%), and UAE (3%). These four countries produce about 91% of cumin of the world, while the remaining production comes from other tropical or sub-tropical Asian and African countries.



Cumin Market Share: Insights from Around the Globe.

Production status in India

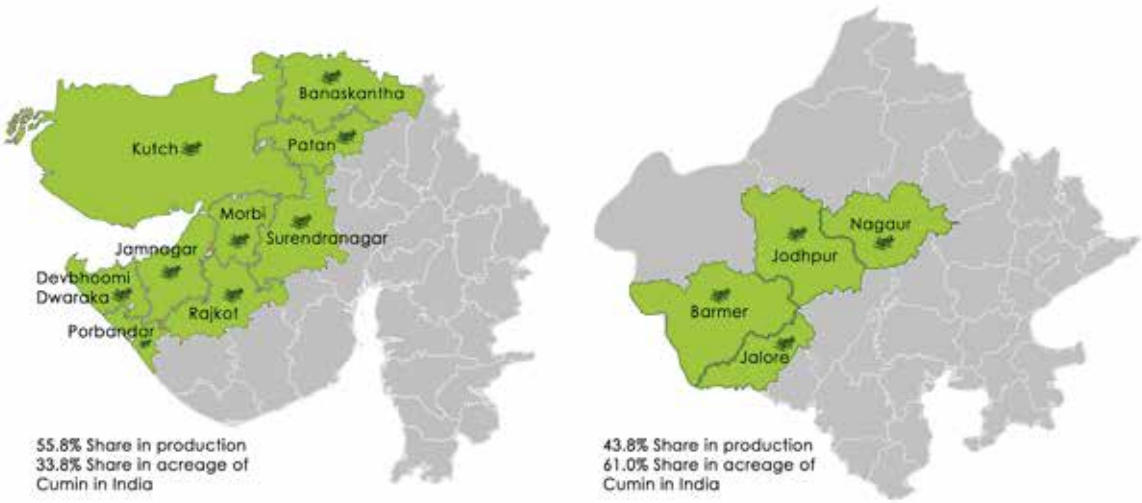
India accounts for almost 70 percent of the world's cumin production. About 80-85 per cent of the domestic output is consumed within the country. In the recent years, cumin cultivation has become more popular due to high economic returns (Meena et al., 2020).



Robust growth in area, production, and yield of cumin in India

India benefits from the fact that the crop harvesting calendar varies across cumin cultivating countries. In India, cumin is grown as a rabi crop-sown during October to December and harvested between February and April. The harvest season in India coincides with the lean season (off season) in other major producing regions, creating a strong demand for the produce.

In the state of Rajasthan, cumin finds its roots in the arid terrains of Barmer, Jalore, Nagaur, Pali, Ajmer, Bhilwara, Tonk, Jodhpur, Jaisalmer, Sirohi, Sikar, and Bikaner. Crossing the border into Gujarat, the aromatic saga continues in the districts of Banaskantha, Sabarkantha, Mehsana, Patan, Junagarh, Jamnagar, Rajkot, Bhavnagar, Amreli, and Surendra Nagar.



Spicing up the Landscape: Cumin Cultivation in Rajasthan and Gujarat.

Based on the latest estimates by Spices Board for the year 2022-23, Rajasthan has the largest area under cumin cultivation i.e., 5.50 lakhs ha, which is 61% of the total area under cumin cultivation in India. Gujarat, with 3.50 lakhs ha, comes second with 38.8 % share in area under cumin cultivation. The cumin production in India registered robust growth in terms of area, production, and yield since the beginning of the 21st century. Taking the triennium ending 2005-06 as the base period, the area and production of cumin has increased by 162 and 288 per cent. The growth in output was supported by the increase in yield of 47.7 per cent between TE 2005-06 and TE 2022-23. In Gujarat, area, production, and productivity of cumin have increased to 331 %, 700 % and 216 %, respectively by the year 2020-21 as compare with 2001-02. At the national level a marked improvement is seen in the growth rate of area, production, and productivity during the last two decades. The yield growth rate increased by 89.9 per cent during the last two decades compared to the growth rate achieved during the 1970-71 to 1999-2000.

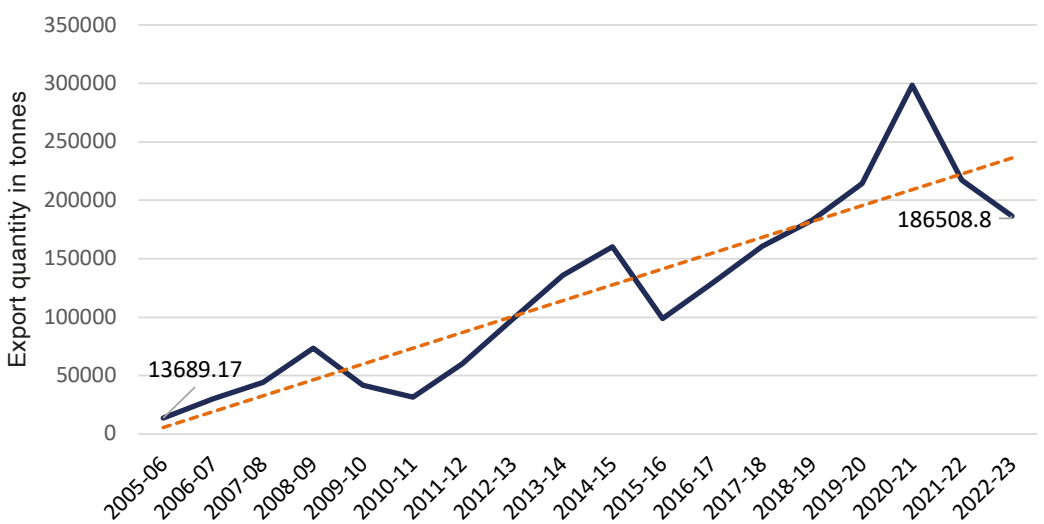
CAGR of area, production, and yield for cumin

	1970-71 to 1999-2000	2000-01 to 2020-21
Area	6.41	7.64
Production	8.40	11.48
Yield	1.88	3.57

The major markets for cumin are also located in the production regions, viz, Rajasthan and Gujarat. The major whole markets are Unjha, Patan, Mohsana, Radhanpur, Jamnagar and Visnagar in Gujarat and Merta city, Jodhpur, Jaipur, Kisangarh, and Kekri in Rajasthan. Apart from this, there are several small-scale markets through which farmers can dispose of their produce.

Status of cumin export

Cumin has emerged as one of the most important commodities in the Indian spice export basket. The increased domestic production of the commodity has increased the exportable surplus, and this has been reflected in the export quantity of cumin. The export quantity has shown a rising trend since 2005-06. The export of cumin has increased from 13689 tonnes in 2005-06 to 233963 tonnes for the TE 2022-23, an increase of more than 17 times. Along with the increased cumin exports, the value-added extracts from cumin, mainly cumin oil and cumin oleoresin, also registered strong export growth.



Rising trend in cumin export from India (2005-06 to 2022-23).

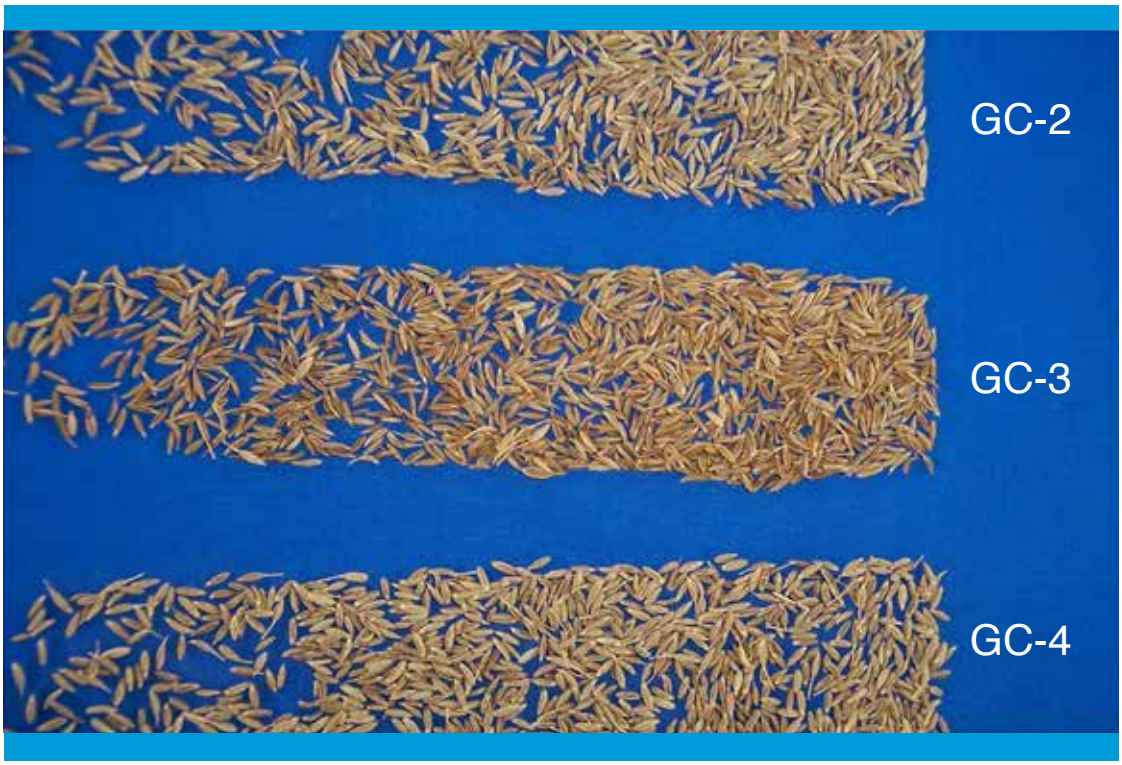
Cumin wilt - The major production constraint in India

Cumin wilt, caused by *Fusarium oxysporum* f. sp. *cumini* (Snyder WC, Hansen NH (1940)), is a severe disease that is limiting global cumin production. It causes high yield losses up to 100% in heavily damaged fields under favorable conditions. The wilting and shriveling of the leaves, the browning of the vascular system, stunting, and damping-off are some of the symptoms caused by the pathogen.The Sardar Krushinagar Dantiwada Agricultural University, Spice Research Centre, Jagudan, Gujarat under ICAR-AICRP Spices identified the high yielding and wilt resistant cumin variety, GC-4 during 2006, which revolutionized the cumin production in India.

Varietal status in cumin

To survive and thrive, Indian cumin farmers need higher yields and lower production costs, as well as tolerance to diseases. ICAR-AICRP Spices has identified the highest yielding cumin as well as disease resistance and regional adaptation. Our next challenge is to further improve yield while maintaining or improving disease resistance and quality to ensure that the industry is sustainable into the future.

Our cumin breeding research is currently supported by the ICAR and SAU's. Two major centres working on cumin varietal improvement are Sardar Krushinagar Dantiwada Agricultural University, Spice Research Centre, Jagudan, Gujarat and Sri Karan Narendra Agriculture University, Jobner, Rajasthan. These centres under AICRP Spices have been developing cumin varieties since the 1960s, with the first commercial release in 1984. To date, we have released 10 cumin varieties in India.



Cumin varieties released in India.

Variety	Important Characteristics
GC-1	Erect plants, bold seeds, wilt tolerance, maturity 105–110 days, average yield 7.0 q ha^{-1}
GC-2	Bushy plants, profuse branching, attractive seeds, maturity 100 days, average yield 7.0 q ha^{-1}
GC-3	Wilt resistant, essential oil content 3.5%, maturity 100 days, average yield 7.0 ha^{-1}
GC-4	Resistant to fusarium wilt, average yield 8.75 q ha^{-1}
GC-5	Early maturing 92 days, average yield 6.86 q ha^{-1}
RZ-19	Erect plants with bold seeds, maturity 120–140 days, average yield 5–6 q ha^{-1}
RZ-209	Wilt tolerance, maturity 140–150 days, average yield 6.5 q ha^{-1}
RZ-223	Wilt tolerance, essential oil content 3.2%, average yield 6.0 q ha^{-1}
RZ-341	Bushy plant, semi erect growth, long and bold seeds, and tolerance to wilt, blight and powdery mildew, maturity 120–130 days, average yield 4.5 q ha^{-1}
RZ-345	Semi erect bushy plants, long and bold seeds, and tolerance to wilt, blight and powdery mildew, maturity 120–130 days, average yield 6.07 q ha^{-1}

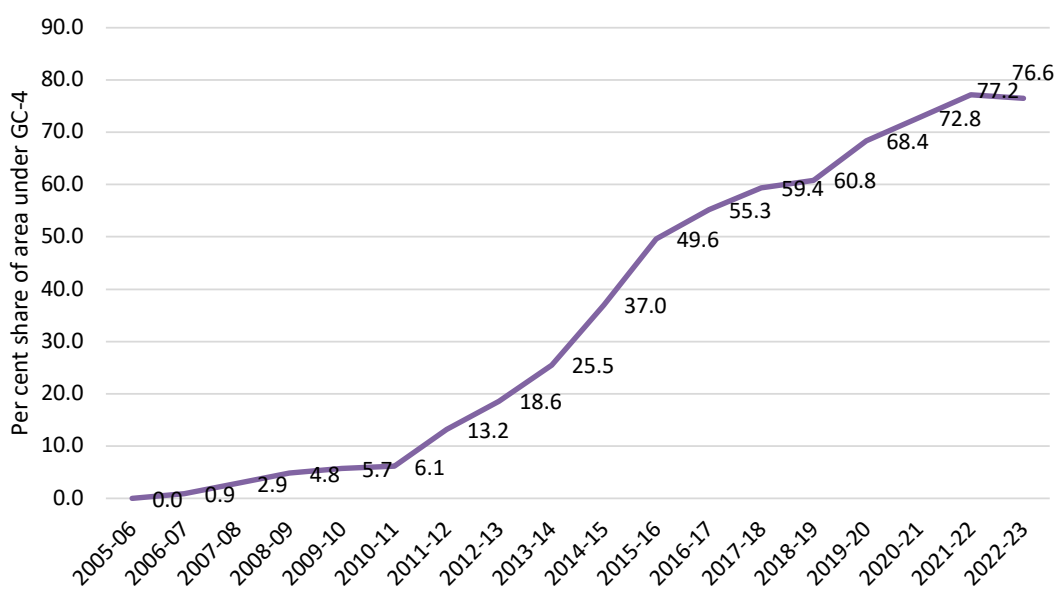
Gujarat cumin 4 (GC-4)

It is a selection from GC-3. During 1998-99, 56 single plants were selected from GC-3 for non- splitting seed habit and bolder grains and evaluated in the sick plot for wilt disease. Ten progenies with high grain yield, bold lustrous grain, non-splitting habit, resistance to wilt were shortlisted. These entries were evaluated for yield and other characters during 2001 to 2005. Seed Spices Research Station (SSRS), Sardarkruishinagar Dantiwada Krushi University (SDAU), Jagudan (Gujarat), along with the ICAR-AICRP on Spices, Kozhikode, Kerala, have played a pivotal role in the development and release of the promising progeny known as Gujarat cumin 4 (GC-4). This has been achieved through conducting rigorous research, evaluation, and effective knowledge dissemination, making a significant contribution to the growth and sustainable cumin cultivation in India.

Varietal dissemination

The first wilt tolerant cumin variety GC-4 was released at the national level during 2006. The variety gained strong farmer acceptance in a short period of time and spread across the cumin growing regions of Gujarat and Rajasthan. Significant increase in the area, production and productivity have been realized at National level after release of GC-4. The variety GC-4 substantially replaced other varieties within a short span of time (2006-2023). Its success is mainly due to the wilt resistance.

The graph depicts the dissemination of the variety GC-4 at the national level, constructed based on expert opinions. Presently, GC-4 is cultivated in about 90 and 60 per cent of the area under cumin in Gujarat and Rajasthan respectively. At the national level, it is estimated that about 77 per cent of the total cumin area is occupied by this variety.



Share of GC-4 in total cumin area in India.

Varietal impact of GC-4 on cumin economy

The development and deployment of the variety GC-4 has had a significant influence on the cumin economy in the country. This is visible across parameters affecting domestic output and export performance. The area production and yield of cumin in India since 2005-06, the year of release of the variety GC-4 is presented below.

GC-4 Unleashed: Fueling cumin area and production growth in India.

Year	Area ('000ha)	Production ('000 t)	Yield (kg/ha)
2005-06	349.0	158.4	453.7
2006-07	409.0	176.5	431.5
2007-08	429.4	172.5	401.7
2008-09	527.1	283.0	536.9
2009-10	517.1	303.9	587.7
2010-11	625.1	473.0	756.7
2011-12	843.4	462.6	548.5
2012-13	868.4	394.3	454.1
2013-14	690.1	445.0	644.9
2014-15	701.6	372.3	530.7
2015-16	808.2	503.3	622.7
2016-17	780.9	500.4	640.7
2017-18	966.2	689.4	713.6
2018-19	1027.9	700.6	681.6
2019-20	1276.3	912.0	714.6
2020-21	1087.0	795.3	731.6
2021-22	869.2	555.8	639.4
2022-23	902.0	627.0	695.1
CAGR	6.2	9.1	2.8

It is estimated that the cumin output from the variety GC-4 across the country was 495.9 thousand tonnes for the TE 2022-23. This is a conservative estimate based on estimated acerage without assigning any yield advantage to GC-4 over other cultivated cumin varieties. Since its release in 2005-06, a cumulative total of 39,66,261 tonnes of cumin production is attributed to GC-4.

Contribution of variety GC-4 to cumin economy (2022-23)

Particulars	Total	Share of GC-4	Estimated Value (GC-4) (₹ Crores)
Cumin Production (tonnes)	659377	495853	10749
Cumin Export (tonnes)	233962	175776	3948
Cumin Oil Export (kg)	16803	12658	3.0
Cumin Oleoresin Export (kg)	76547	57896	9.9
Total			**14710**

Note: The commodities are valued at 2022-23 prices. The wholesale price of cumin in Unjha market for the year 2022-23 is used to assign value of cumin production. The export unit value for the year 2022-23 is used for valuation of exported commodities. It should be noted that these estimates reflect only the contribution of variety to various sectors and are not based on the value of the final product.

The increased production and availability of cumin through the deployment of the variety GC-4 was instrumental in strengthening the export profile of the crop in the spice basket. The export quantity of cumin increased by eight times between TE 2007-08 (when cumin production from GC-4 started arriving regularly in the markets) and present (TE 2022-23). The enhanced availability must have influenced the shift towards value added extracts from cumin. The export quantity of cumin oleoresin saw an increase by nearly 30 times during the same period whereas the cumin oil exports increased by a factor of 3.6.

Export earnings

The cumin crop is noted for its export orientation. It is one of the most important constituents of the spice export basket of the country. After chillies, cumin contributed the most to the aggregate export earnings from spices. During 2022-23, India exported 186,509 tonnes of cumin valued at 4193.6 crores. Using our conservative estimates on the contribution of the variety GC-4 to the various items of exports, the export earnings that can be attributed to GC-4 since its development was estimated and given in the table below. The exports of whole cumin, essential oils and oleoresins from the variety GC-4 is estimated to have a cumulative export earnings of ₹ 25480.5 crores at current (2022-23) prices. The exports of essential oils and oleoresins have picked up during the last decade and the strong growth trend in export earnings is expected to sustain in the medium term.

Estimates of revenue generated from export of GC-4 (2022-23 prices)

Particulars	Value
Export earnings from GC-4 – whole cumin	25380 Crores
Export earnings from essential oil from GC-4	25.2 Crores
Export earnings from oleoresins from GC-4	75.3 Crores
Total export earnings from GC-4	**25480.5 Crores**

Success stories

Income enhancement through seed production

Mr. Devrajbhai Amthabhai Patel, Varsada, Taluka Kankrej, Dist. Banaskantha, Gujarat has 25 acres of cultivable land. The traditional cropping pattern of Mr. Patel was mustard, cotton, castor, and cumin before 2004 and his earnings was only about ₹ 3.0 lakhs due to traditional method of cultivation and use of local or traditional varieties. Field demonstrations of released variety Gujarat Cumin 4 (GC-4) was conducted in this area under All India Coordinated Research Project on Spices by SSRS, Jagudan, Gujarat. This has motivated Mr. Patel to expand the area of cumin. The other farmers of this village and neighboring villages also started sowing GC-4 variety and now it has become highly popular and major source of income to the farmers. Mr. Patel started seed production of Gujarat Cumin 4 variety and produced about 5000 kg of truthfully labelled seeds of GC-4 and distributed to cumin farmers. His farm income has increased from ₹ 3.0 to 20.0 lakhs by varietal adoption and seed production programme.

Scientific Seed Production of GC-4 Cumin Variety in Gujarat

GOCHNAD – A first cumin seed village

Gochnad village of Radhanpur taluka, Patan district, Gujarat is a traditional cumin growing village under conserved moisture conditions. The farmers were mostly growing local/Gujarat Cumin - 2 with traditional system of farming till 2007. Gochnad This village was adopted by SSRS, Jagudan as a cumin seed village during 2008 to demonstrate GAP of cumin to enhance production and productivity. Farmers were also motivated and trained for village level quality seed production. Initially 12 farmers under the leadership of Mr. Devanbhai Bhagvanbhai Chaudhary came forward to take seed production programmes. The breeder seed was supplied to them from SSRS, Jagudan and the group produced 18243 kg of truthfully labelled seeds. The farmers were motivated to form a Farmers' Club for seed production of cumin (GC 4). With the help and efforts of SSRS, Jagudan and NGOs, the first farmers' club of cumin seed production 'Shree Mahashakti Farmer Club' was formed and registered under the chairmanship of Mr. Devanbhai Bhagvanbhai Chaudhary with 12 members during 2009. through NABARD. Now the club has 65 farmer-members producing foundation and certified seeds of Gujarat Cumin 4. During 2009- 10 to 2015-16, a total of 477610 kg and 30582 kg of certified/ TF and foundation seed was produced by this club, respectively. The seeds were distributed to farmers within the state and neighboring states. The production of large quantity good quality of seeds enabled to increase the seed replacement ratio from 22.5 (2008-09) to 62.0 (2012-13) and productivity of cumin from 670 kg/ha to 900 kg/ha. Considering the significant role of this farmers club in enhancing production as well as productivity of cumin in Gujarath it was awarded by NABARD during 2012.

GC-4 in the arid climate of western Rajasthan

Shri Bhanwar Lal, S/o Shri Peera Ram, Sirmandi (Shreeram Nagar), Tehsil - Osian, Jodhpur, Rajasthan - 342303 supported by Agricultural Research station, Mandor through KVK, Phalodi, Jodhpur, Rajasthan adopted GC4 and followed scientific cultivation of cumin right from field preparation to harvesting. He plays a vital role in distributing high-quality seeds of GC-4 variety to neighboring farmers. He preferred cumin variety GC 4 due to higher production than local variety. The incidence of wilt and powdery mildew diseases was negligible. The yield of cumin ranged from 10-12 quintals per hectare with an average net income of ₹ 1.25-1.50 lakhs per hectare.

Shri Kalu Ram aged 55 has seven-hectare landholding. Earlier, he used to grow a local variety of cumin (4.5-5.5 quintals per hectare), but the income was not satisfactory because this variety was highly susceptible to wilt disease. He used to earn a net income of ₹ 32500- 47500 per hectare. In the year 2018, the Agricultural Research Station, Mandor, Rajasthan advised him to cultivate GC 4 variety of cumin with improved production and protection technologies. Since then, he has been cultivating the cumin GC-4 variety in six hectares for the past five years. The yield of cumin ranged from 10-12 quintals per hectare and earning net income ₹ 115000-145000 per hectare. Now he is producing seeds of GC-4 in farmer participatory mode with Agriculture University, Jodhpur and encouraging other cumin growing farmers of region for seed production.

A way forward

- Development of suitable varieties with improved quality parameters of cumin exclusively for export purposes.
- Area expansion using quality enhanced seeds.
- Identification of farmers groups and farming clusters.
- Development of seed spices export zones based on the agroclimatic conditions.
- Organizing training programs and farmers exposure visit to cumin growing areas on Sustainable Agricultural Production.
- Setting up processing units in identified zones with Good Manufacturing practices (GMP).
- Promoting research on developing packaging and storage of cumin.
- Promoting research on, product development, value addition and organic production for export purposes.

Seed Spices Research Station (SSRS),
S. D. Agricultural University (SDAU), Jagudan, Gujarat

&

ICAR-All India Coordinated Research Project on Spices,
Kozhikode, Kerala