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Jodhpur Jeera-1: High seed yielding variety of cumin for Rajasthan

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ABSTRACT

Jodhpur Jeera-1 (MCU-105) is a newly developed high-yielding cumin (*Cuminum cyminum* L.) variety developed through pure line selection from a local germplasm collection (GP-205) at Dr. B.R. Choudhary Agricultural Research Station, Mandor, Agriculture University Jodhpur, Rajasthan. The variety was evaluated under the AICRP on Spices at five locations across Rajasthan and Gujarat for three consecutive years (2021-22 to 2023-24). In multi-location coordinated trials, Jodhpur Jeera-1 recorded a weighted mean seed yield of 566 kg/ ha, registering a 22.8% yield advantage over the national check variety GC-4 (469 kg/ ha). The variety possesses a superior essential oil content of 4.34%, which is 3.6% higher than that of GC-4 and is characterized by a tall, erect plant type with abundant branching and compact umbels. It matures in 118–138 days, placing it in the medium maturity group. Under natural field conditions, Jodhpur Jeera-1 exhibits moderate resistance to both Fusarium wilt and Alternaria blight, recording a mean blight disease incidence of 26.0% compared to 34.4% in GC-4, along with lower infestation by aphids and thrips. The variety was recommended for commercial cultivation in irrigated, timely sown *rabi* conditions of Rajasthan in 2025.

Introduction

Cumin (*Cuminum cyminum* L.) is an important annual herbaceous spice crop belonging to the family Apiaceae. It originated in the Irano-Turanian region, including the Eastern Mediterranean to South Asia, and has been cultivated since ancient times. Cumin is cultivated in many parts of the world, particularly in India, Iran, Syria, Turkey and other regions (Singh *et al.*, 2023). India is the world's largest producer and exporter of cumin, contributing about 70% of global production (Ramesh *et al.,* 2025). In India, cumin is cultivated over approximately 10.94 lakh hectares, with a production of about 7.24 lakh tonnes during

2024–25. The average productivity is around 662 kg/ha (Anonymous, 2025). Rajasthan and Gujarat states together accounted for over 80–99% of the national area and production of cumin.

It is a medicinal and aromatic plant that has been used since ancient times for its distinctive flavor, primarily derived from its essential oil (mainly cuminaldehyde, 2–5%). It is widely used in food preparations, including curries, pickles, soups, sauces, bakery products and liquors. Additionally, cumin is valued in traditional medicine for its therapeutic properties, particularly in the treatment of digestive disorders, cough, and flatulence (Merah *et al.*, 2020).

Cumin is a cool-season, *rabi* crop mainly grown during the winter in northern and western India, thriving in arid and semi-arid regions. High humidity during flowering and fruiting promotes fungal diseases, while excessive heat or frost can reduce yield. The crop needs 120 frost-free days and is vulnerable to hot, dry winds or excess moisture at maturity (Allaq *et al.,* 2020).

Biotic and abiotic stresses, along with management practices, significantly affect yield and quality. Like other seed spices, cumin is attacked by several fungal diseases. Alternaria blight (*Alternaria burnsii* or *A. alternata*) is one of the most important and devastating diseases, yield losses up to 50–80% under favorable conditions (humid, cloudy weather). Other major diseases include wilt (*Fusarium oxysporum* f. sp. *cumini*) and powdery mildew (*Erysiphe* spp.), leading to substantial economic damage in major growing areas like Rajasthan and Gujarat (Dharajiya *et al.,* 2023).

In light of these circumstances, a breeding program was undertaken to develop high-yielding cumin varieties with resistance to Alternaria blight and Fusarium wilt through systematic evaluation of available germplasm.

Material and Methods

Evaluation of advance cumin breeding lines

Cumin germplasm and breeding lines were evaluated at the Dr. B. R. Choudhary Agricultural Research Station, Mandor (Rajasthan) during *rabi* season for two successive years 2019-20 for seed yield potential and disease resistance in augmented block design. Further, in initial varietal trials (IVT) in the year 2020-21 at three locations *viz.,* Mandor, Jalore and Samdari, laid out in randomized block division (RBD) with three replications. The row to row and plant to plant distance was maintained at 30 cm and 5-7 cm, respectively. The crop was raised following the recommended agronomical and plant protection methods.

Among the germplasm and breeding lines, MCU-73 and MCU-105 were found superior and selected for further evaluation. Both the entries were further evaluated under coordinated varietal trials (CVT) at five different locations *viz.,* Ajmer (Rajasthan), Mandor (Rajasthan), Jobner (Rajasthan), Sanand (Gujarat) and Jagudan (Gujarat) for three consecutive years 2021-22, 2022-23 and 2023-24. Three years pooled data of all the five locations were analysed and presented in All India Coordinated Research Project on Spices (AICRPs) for superiority against national check variety GC-4. The data were subjected to analysis of variance (Panse and Sukhatme, 1986) and a pooled analysis of variance, where genotypes were assumed as fixed and test environments as random factors (Peterson, 1938).

Pedigree

Cumin variety Jodhpur Jeera-1 (JJ-1) has been developed from the germplasm material collected from Merta area of Nagaur district, Rajasthan. Pure line selection of breeding method was employed to select superior plant type (GP-205). Further the genotype was evaluated under AICRP on Spices using codes MCU-105. Based on its performance over the years and locations, the advanced entry MCU-105 (code CUM-47) has been recommended for release in the Annual Group Meet XXXVth AICRP on Spices workshop held during 15-17th October, 2024 CCS HAU, Hisar. Subsequently, advanced entry MCU-105 was released and notified as variety in the name of Jodhpur Jeera-1 (Gazette Notification S.O.No./4000 (E); dated 01.09.2025).

Results and Discussion

Yield performance under initial evaluation trials

Total 6 genotypes along with one check variety GC 4, were evaluated at ARS, Mandor, Jalore and ARSS, Samdari. Two test entries, MCU-73 (542 kg/ ha; 19.6%) and MCU-105 (522 kg/ ha; 15.2%) were found superior over check variety GC-4 (453 kg/ ha). Based on these yield performances, the genotypes MCU-73 and MCU-105 were contributed to AICRP trials.

Table 1. Seed yield performance of cumin entries against check GC-4 over location and years

S.No.	Entry	Seed yield (kg/ ha)					% increase over check
		Mandor 2019-20	Mandor 2020-21	Jalore 2020-21	Samdari 2020-21	Mean	
1.	MCU-73	567	817	611	175	542	19.6
2.	**MCU-105**	**581**	**728**	**634**	**146**	**522**	**15.2**
3.	MCU-2	532	578	603	97	452	-0.2
4.	**GC-4 (C)**	**444**	**639**	**592**	**139**	**453**	
	G. Mean	323	559	528	114	381	
	SEm±	23	43	27	9		
	CD at 5%	67	133	84	28		
	CV (%)	12.4	13.4	8.9	13.6		

Table 2. Seed yield of cumin varieties in coordinated trials at different locations

Particulars	Mean seed yield (kg/ ha)			Weighted mean	Percent increase over national check GC-4
Year of testing	2021	2022	2023		
Entries/ No. of locations	5	3	2	10	
Check (GC-4)	**513**	**335**	**560**	**469**	**-**
CZC-94	299	147	534	300	-38.7
CZC-135	591	393	545	522	12.3
MCU 73	487	359	595	470	0.8
MCU 105	**584**	**470**	**664**	**566**	**22.8**
JC 18-10	414	200	275	322	-31.9
JC 18-09	372	143	331	295	-39.2
UC 350	405	262	515	384	-18.6
UC 257	187	95	636	249	-50.6
UC 250	227	162	692	301	-38.6
SPS/166/2-3	256	168	562	291	-39.9
BC 13	348	257	457	343	-26.7

Yield performance under multi-location testing

Under AICRP on Spices, the advanced entry MCU-105 (code CUM-47) was performed better as compared to other entries along with national check. Three years pooled data of seed yield for each evaluating centre are presented in Table 2, revealed that the seed yield of proposed entry MCU-105 (584 kg/ ha, 470 kg/ ha, 664 kg/ ha) was found to be superior over national check GC-4 (513 kg/ ha, 335 kg/ ha, 560 kg/ ha) over the years and gained 22.8% higher pooled yield. The consistent performance of MCU-105 over three consecutive years (2021-22 to 2023-24) and across five diverse locations in Rajasthan and Gujarat demonstrates that its yield advantage is stable and not a location- or season-specific phenomenon. Such genotype × environment consistency is a critical criterion for the release of any new variety (Ramesh *et al.*, 2025).

Quality performance

The essential oil content in the variety was considered as quality parameter for the release, henceforth, essential oil was extracted from the dried seed of cumin every year using hydro-distillation method. Three years cumulative data of essential oil are presented in Table 3, revealed that the proposed advanced entry MCU-105 (JJ-1) contained 4.34% essential oil, which was 18.5 per cent higher than national check GC-4 (4.19%). JJ-1 consistently outperformed or matched GC-4 across most AICRP centers in essential oil accumulation, with particularly high values at Jagudan (4.80%) and Sanand (4.94%), suggesting that irrigated, warm-humid agroclimatic zones of Gujarat may further enhance oil biosynthesis in this variety.

Table 3. Essential oil (%) content in seed of the cumin variety tested at various AICRP centres (pooled data 2021-22 to 2022-23)

Location-season	MCU-105	GC 4	Mean	F (Prob)	CD (p=5%)	CV (%)	SE (m)
Ajmer-2022	3.55	3.51	3.31	0.026	0.412	7.354	0.141
Ajmer-2023	3.96	3.87	4.06	0	0.101	1.467	0.034
Jagudan-2021	4.8	4.4	4.66	0	0.348	4.41	0.119
Jagudan-2022	4.73	4.27	4.66	0	0.348	4.41	0.119
Jagudan-2023	4.13	3.4	3.63	0.016	0.593	9.661	0.202
Jobner-2021	4.54	5.18	4.79	0	0.264	3.249	0.09
Jobner-2022	4.43	4.4	4.34	0	0.394	5.352	0.134
Jobner-2023	3.96	4	4.17	0.003	0.649	9.189	0.221
Sanand-2021	4.94	4.68	5.3	-	-	-	-
Grand Mean	4.34	4.19	4.33	-	-	-	-
% higher than GC-4					18.5%		

Resistance to Alternaria blight and Fusarium wilt

The new variety Jodhpur Jeera-1 (MCU-105) possess moderately resistance to Alternaria blight and Fusarium wilt, which causes severe yield loss in cumin. Percent disease index showed that MCU-105 received lower disease incidence as compared to National checks GC-4 (Table 4). Based on three years pooled data, 26.0% PDI blight disease recorded in proposed variety against 34.4% in national checks GC-4. Dharajiya *et al.* (2023) demonstrated that resistance to *F. oxysporum* f. sp. *cumini* in GC-4 involves up-regulation of specific metabolic pathways, and it is likely that JJ-1 has evolved partial resistance through different or overlapping biochemical mechanisms that merit further investigation.

Table 4. Performance of MCU-105 genotypes against Alternaria blight and Fusarium wilt disease in CVT (pooled data 2021-22 to 2023-24)

Disease	Item	JJ-1 (MCU-105)	National Check GC-4
Wilt	1st year	12.0	11.0
	2nd year	29.8	23.7
	3rd year	24.4	28.5
	Mean	22.1	21.1
Blight	1st year	18.4	33.2
	2nd year	31.2	38.8
	3rd year	26.8	29.8
	Mean	26.0	34.4

Plate 1. Plant of Jodhpur Jeera-1 at seed formation stage

Plate 2. Seeds of Jodhpur Jeera-1

Adaptability and stability

JJ-1 was evaluated across five geographically diverse locations *i.e.* Ajmer, Mandor and Jobner in Rajasthan that collectively represent the major cumin-growing agroclimatic zones of Rajasthan. The variety demonstrated above-average performance across all three years of testing, with particularly strong yield expression in the third year (664 kg/ ha at pooled level), suggesting good adaptation to evolving crop management conditions and climatic variability. This broad adaptability is a key requirement for commercial release under the AICRP system (Ramesh *et al.,* 2025).

The variety's maturity duration of 118–138 days places it in the medium maturity group, which is well-suited to the *rabi* cropping schedule of Rajasthan, allowing farmers flexibility in sowing time while avoiding terminal heat and moisture stress during grain filling. Its upright growth habit and compact canopy also facilitate mechanized harvesting and reduce lodging risk, which are increasingly important traits as the farming workforce in Rajasthan transitions toward mechanization.

Conclusion

Jodhpur Jeera-1 (MCU-105), developed through pure line selection from local germplasm represents a significant advancement. JJ-1 recorded a weighted mean seed yield of 566 kg/ ha. It was 22.8% higher than the national check GC-4. It showed higher essential oil content (4.34%). The variety exhibited moderate resistance to Alternaria blight and Fusarium wilt. It also showed broad adaptability across major cumin-growing regions of Rajasthan and Gujarat. Overall, JJ-1 offers a comprehensive agronomic advantage under irrigated *rabi* conditions.

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Conflict of Interest

The authors have no conflict of interest to declare.

Data Sharing

All relevant data are included in the manuscript.

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