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Ajmer Coriander - 3 (ACr-3): A high yielding and powdery mildew resistant coriander variety

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Abstract

A new coriander variety ACr-3 had been released with an average seed yield (16.88 q ha⁻¹), essential oil (0.55%) and powdery mildew resistance. The variety was recommended for release in Annual Group Meet XXIX AICRPS workshop held at Dr. YSPUH & F Solan (H.P.) during 4-6th Oct.2018 and notified vide S.O.4272 (E) dated 26.11.2019 for commercial cultivation under timely sown, with recommended POP for growing areas of Rajasthan. This variety is performing well at farmer field and adoption of new coriander variety ACr-3 by the coriander growers will increase their farm productivity and income, thus improving their livelihood besides, better sustenance of spice industry in the country and fetching more foreign exchange.

Keywords: ACr-3, high yielding, essential oil, powdery mildew.

Introduction

Coriander (*Coriandrum sativum* L., 2n = 22) is a seed spice crop which is native to the Mediterranean region, belongs to *Apiaceae* family and is considered an annual herb. Coriander plant is considered as a medicinal herb in traditional medicine system as it has various properties like they act as antioxidant, anti-inflammatory, analgesic, antibacterial, antifungal, and insecticidal properties (Kiran et al., 2009; Lo Cantore et al., 2004). In addition to this, coriander seeds are a good source of secondary plant metabolites such as polyphenols, especially phenolic acids, and flavonoids (Tylewicz et al., 2018).

Its leaves and seeds are used as a condiment and for culinary purposes. (Coskuner and Karababa, 2006). Its green leaves, containing proteins, vitamins and minerals (like calcium, phosphorus, and iron), fibres and carbohydrates and it is used as vegetable and salad. It is also rich in varying components, which provides typical flavour, when added to the food products and acts as preservative (Kalemba et al., 2003). India is the major coriander producing country in the world. In India, coriander is largely cultivated in Rajasthan, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Orissa, Uttar

Pradesh, and Uttaranchal (Msaada *et al.*, 2007). Rajasthan is major coriander growing state with its share of about 60% in the total area and production of the country. In India, annual coriander seed production was 7,56,000 tonnes in 2019-20, grown on 6,29,000 ha with a productivity of 1202 kg ha⁻¹ (Anonymous, 2019-20). The major components were found linalool (75.30%), geranyl acetate (8.12%) and α -pinene (4.09%), Singh *et al.*, (2006). Ganesan *et al.*, (2013) was reported that matured coriander leaves are rich in moisture (87.9%), protein (3.3%), carbohydrate (total sugar 6.5%) and total ash (1.7%). It was also reported that potential source of high-value compounds for functional foods and nutraceuticals value. Molecular techniques for detecting differences in the DNA of individual plants to examine variability in cultivar are useful for identification of potential parental lines. These differences in general are called molecular marker and have characterization as well as various phylogenetic analysis in various plant species with reliable and authentic results. Despite the large demand and cultivation of this crop in India, the average seed yield of coriander is low compared to other countries due to a lack of improved varieties. Powdery mildew, caused by *Erysiphe polygoni* DC, is a significant disease that has been a major constrain in quality leaf and seed production. Development of a resistant variety of coriander is an environmentally friendly way to manage powdery mildew (Amin *et al.*, 2017). Considering the above facts, there was a need to develop a high-yielding coriander variety that is disease resistant as well. A new coriander variety ACR-3 was developed and released in 2019 for coriander-growing areas of Rajasthan by ICAR-NRCSS Ajmer. This variety is performing well in the farmers' fields and the adoption of ACR-3 by the coriander growers will increase their farm productivity and income, thus improving their livelihood besides better sustenance of spice industry in the country.

Materials and methods

The present study was carried out in *rabi* season during 2015-18 at five centers across the country under all India coordinated trails (Ajmer, Jobner, Kota, Jagudan, Pantnagar). The study was carried out with 28 genotypes of coriander including checks (RCr-728 & Hissar Anand). The experiment was laid in Randomized block design (RBD) design. Plot size 4 X 2.5, row to row spaced 50 cm apart. Plant spacing within rows was maintained 20 cm. The recommended package of practices was adopted for raising healthy crop. Twenty plants were randomly selected from each line and observations were recorded on plant height, primary branches, umbel per plant, umbellate per umbel, seeds per umbellate, test weight and yield (g). Essential oil extracted using hydro distillation in Clevenger type apparatus.

Pedigree: This variety (population) has been developed from the germplasm which was collected in the region of Mehsana, Gujarat (IC-630755). Breeding method was used recurrent selection for developing this variety. This variety was entered for testing under AICRPs network project during 2013-18 by code ACR-4, Cor-109, Cor-136 & Cor-160. Seed shape was oval.

Selection procedure: The selected superior high yielding plants are evaluated under replicated trail in RBD design for seed yield performance & powdery mildew resistance for the three year at NRCSS-Ajmer from 2015-2018 at Ajmer, Jobner, Kota, Jagudan, Pantnagar. The variety was recommended for release in Annual Group Meet XXIX AICRPS workshop held at Dr. YSPUH & F Solan (H.P.) during 4-6th Oct. 2018.

Results and discussion

Varietal description

Yield performance in multi-location AICRP trials

Variety was evaluated for five years at 5 locations (2013-18) across all regions of country, however, variety performed well in across the country. The

Trait	Description
Plant	Medium in height, semi-erect, branched plant type
Seeds	Seeds are bold and oval in shape.
Maturity	Main season variety with maturity 120-130 days
Biotic stress resistance	This variety is resistant to powdery mildew disease
Quality traits	Seeds have good aroma with volatile oil 0.55 %.
IC number	IC-630755
Other attributes	Dry cool and frost free environment particularly in January is most suitable for exploitation of full genetic potential.

Table 1. Summary of performance of coriander varieties in Station and coordinated trials at different locations across the State for Seed yield (kg ha⁻¹)

Particulars	Proposed entry (ACr-3)	National check Hisar Anand	National check RCr-728
Years of testing	2013-14 to 2017-18	2013-14 to 2017-18	2013-14 to 2017-18
Total yield over the locations/years	28708	18821	21399
No of locations / years	17	15	15
Mean	1688.6	1254.7	1426.6
% increase over national check Hisar Anand			34.6
% increase over state check Rcr-728			18.3

Table 1a. Seed yield (kg ha⁻¹) of coriander varieties in Station and coordinated trials at different locations across the country (2013-18).

Year	Location	ACr-3	Hisar Anand	RCr-728
2013-14	SCT Ajmer	1820	-	-
2014-15		2111	-	-
2015-16	Ajmer	1374	681	1049.3
2016-17		2116	1800	1870
2017-18		2066	1113	1504
2015-16	Jobner	1582	1162	1043
2016-17		1981	1894	2078
2017-18		1502	1729	1384
2015-16	Kota	1125	229	792
2016-17		1535	2170	1545
2017-18		1104	1392	1252
2015-16	Jagudan	1221	603	777
2016-17		1552	2029	1628
2017-18		757	812	431
2015-16	Pantnagar	2319	1023	2083
2016-17		2477	1296	2000
2017-18		2065	1500	1963
	Mean	1688.6	1254.7	1426.6
	% increase over Hisar Anand (National Check)		34.6	
	% increase over RCr-728 (National Check)			18.37

Table 2. Trial on screening of coriander entries against powdery mildew disease of coriander under natural condition at Jobner

Entry	2015-16	2016-17	2017-18	Reaction
ACr-3	76.67	-	38.33	Moderately resistant
RCr-728	68.33	-	55.00	Susceptible
HisarAnand	75.00	-	55.00	Susceptible

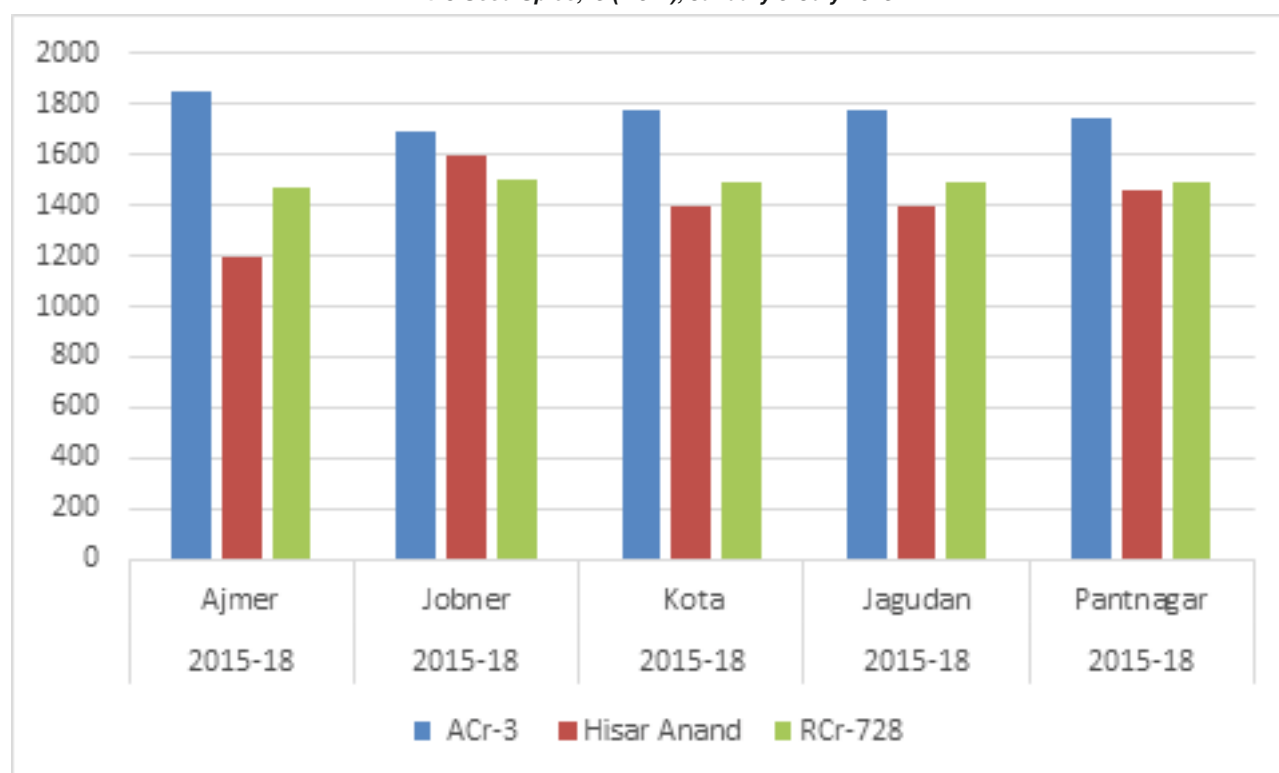


Fig. 1. Average seed yield performance of ACr-3 at different locations during 2015 to 2018.

Table 3. Essential oil (%) content in seed of the proposed variety tested at Jobner centre (*Rabi* 2012-13 to 2014-15)

S. No.	Name of entries	Essential oil	% higher than Hisar Anand	% higher than RCr-728
1	ACr-3	0.55	22.2	7.84
2	HisarAnand	0.45		
3	RCr-728	0.51		

Table 4. Constituent of essential oil in ACr-3 genotype as compared to ACr-1 Variety (check)

Compound	ACr-3	ACr-1
Alpha pinene	1.149	4.223
Beta pinene	0.121	0.202
Cymene	1.628	2.281
Gama terpinene	3.040	6.856
Linalool	75.42	69.986
4-allyl anisol	0.213	0.993
Geraniol	2.179	2.033
Anethole + estryragol	0.430	1.267
Geranyl acetate	15.58	11.637

Table 5. Allele size observed in samples

Primer name		Samples		
ISSR 12	ACr-1	ACr-2	ACr-3	
1600	1	1	1	
1450	1	1	1	
1200	1	1	1	
800*	1	0	0	
700	1	1	1	
600	1	1	1	
400	1	1	1	
300*	1	1	0	

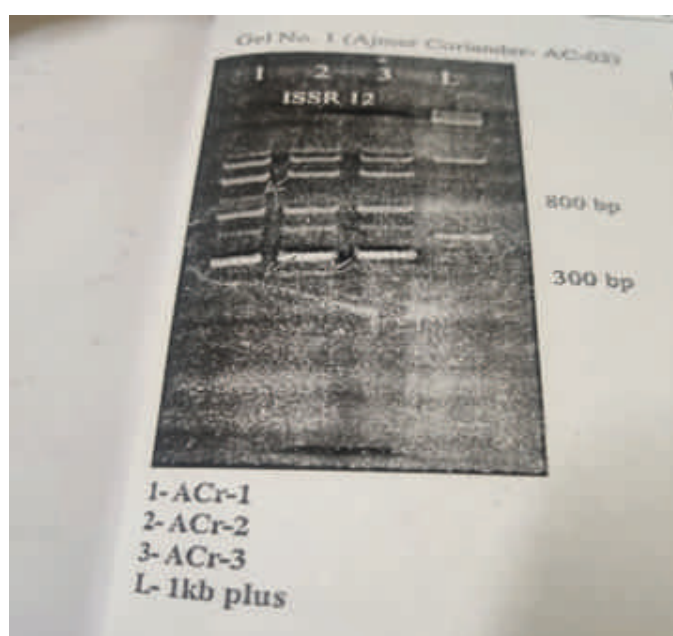


Fig. 2. Allele size observed in samples



Field view and seed of ACr-3

results are described below-In replicated trial at different locations over the country variety gives average seed yield 1688.6 kg ha⁻¹. The seed yield was higher than 34.6% over the national check Hisar Anand and 18.3% higher than state check RCr-728. (Table 1 & Table 1a).

ACr-3 gave average performance of seed yield in Ajmer (1852 kg ha⁻¹), Jobner (1688 kg ha⁻¹), Kota (1254 kg ha⁻¹), Jagudan (1176 kg ha⁻¹), Pantnagar (2287 kg ha⁻¹) which is higher than check variety Hisar Anand & RCr-728. (Table 1a & Fig 1).

Disease resistance:

The three year trial conducted on screening of coriander entries against powdery mildew disease of coriander under natural condition at Jobner. The variety ACr-3 found moderately resistant while the check varieties (RCr-728 & Hisar Anand) found susceptible. (Table. 2).

Essential oil: The three year trial conducted on essential oil (%) content in seed of the proposed variety tested at Jobner centre. Essential oil (%) found 0.55 which was higher (22.2) than Hisar Anand (Table 3).

Essential oil Constituent: Essential oil of ACr-3 seeds constituents alpha pinene (1.149), beta pinene (0.121), cymene (1.628), gamma terpinene (3.040), linalool (75.42), 4-allyl anisole (0.213), geraniol (2.179), anethole + estragole (0.430) and geranyl acetate (15.58). The high linalool present as compare to check is indicates that ACr-3 have more aroma, So the variety also can be use for aromatic purpose also (Table 4).

DNA finger printing of ACr-3: DNA fingerprinting of the variety was done using ISSR primers (ISSR 12). The primer generated polymorphic bands and showing clear-cut difference between the check (ACr-1 & ACr-2) and released variety (ACr-3). The ISSR band 300 is showing presence in ACr-1 & ACr-2 where as it was absent in ACr-3 (Table 5 & Fig -2).

Distinguishing morphological characteristics: The ACr-3 plant has 6-10 basal leaves which is raised with 45 degree angle. Its plants have semi-erect growth habit, medium primary branches (6-10), tall plant height, good seeds per umbellate and oval shape seed colour.

Agronomic management

The optimum seed yield can be obtained by adopting standard agronomical practices. Best sowing time was

recorded 2 and 3rd week of October, Seed rate of this variety is needed approximately 10-12 kg ha⁻¹. Line to line distance 30 cm and plant to plant 20 cm distance should be maintained respectively. This variety is suitable for loamy and clay loam soils having good drainage facility. 5-6 irrigations are required to get good seed yield depending on soil type and climatic conditions in conventional method and when irrigation is given by drip method water should be given at 0.8 IW/CPE ratio. Fertilizer and manure are required 5-10 t ha⁻¹ FYM, 60 kg N, 30 kg P₂O₅ and 20 kg K₂O ha⁻¹ to get good yield.

Conclusion: Compared to existing varieties, coriander variety ACr-3 demonstrated a high seed yield and resistance to diseases. It is performing well on farmer's fields and adopting ACr-3 by coriander growers will increase their farm productivity.

Conflicts of Interest : The authors declare no conflicts of interest.

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