Int. J Seed Spice, 13 (1 & 2), January & July, 2023: 64-69 DOI: https://doi.org/10.56093/IJSS.v13i1-2.9

Reviewed by
Dr. Rukam Singh Tomar
ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India
Email:rukamsingh.tomar@icar.gov.in

***Correspondence**
R. S. Meena
rsm.nrcss@gmail.com

Received: 12 August 2024
Revision: 10 September 2024
Accepted: 07 October 2024

Citation
Meena, R.S., Lal, G., Choudhary, S. and Meena, R.D. 2023. A high yielding Celery (*Apium graveolens*) variety A-Cel-2 (Ajmer Celery-2) for better resistance, quality with higher essential oil content to grow in Rajasthan *Int. J Seed Spice,* 13(1&2): 64-69

DOI
https://doi.org/10.56093/IJSS.v13i1-2.9

Affiliation
[1]ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer – 305 206, Rajasthan, India

A high yielding Celery (*Apium graveolens*) variety A-Cel-2 (Ajmer Celery-2) for better resistance, quality with higher essential oil content to grow in Rajasthan

R.S. Meena, G. Lal, S. Choudhary and R.D. Meena

Abstract

A high yielding variety A-Cel-2 (Ajmer Celery-2) was released and notified by the Rajasthan State Seed Sub- Committee for Agricultural and Horticultural Crops in 33rd meeting on date of 23August, 2019 at Jaipur (Rajasthan) (Notified vide S.O.1480 (E) dated 01.04.2021). This variety is recommended for commercial cultivation in all celery-growing regions of Rajasthan under timely sown conditions following the recommended POP. A-Cel-2 boasts an average seed yield of 874.3 kg ha^{-1}, which is 23.2% higher than the check variety A-Cel-1 in multi-location trials across Rajasthan. Additionally, it achieved a yield of 623 kg ha^{-1} at ICAR-NRCSS, representing a 49.87% increase over A-Cel-1. Moreover, the essential oil content of A-Cel-2 is 17% higher, indicating superior quality compared to the check. This variety thrives in clay loam to sandy soils with good drainage and is expected to significantly boost celery production, improving the socio-economic status of farmers in Rajasthan.

Keywords: Celery, Ajmer Celery-2, high yield, disease resistance, quality, higher essential oil

Introduction

Celery (*Apium graveolens* L., diploid species 2n=2x=22) is a cultivated plant belonging to the species *Apium graveolens* in the family Apiaceae that has been used as a vegetable since ancient times. This crop is originated from the Mediterranean basin, and widely cultivated in Sweden, Egypt, Algeria and Ethiopia and Asia. It has a broad native distribution from Macaronesia in the west, through Europe as far as the western Himalayas, and through North Africa to the Arabian Peninsula (Gauri *et al.,* 2015). *Apium graveolens* is a species of flowering plant in the family Apiaceae. The crop is naturally cross-pollinated but not self-incompatible. It is used as an aphrodisiac, anthelmintic, antispasmodic, carminative, diuretic, emmenagogue, laxative, sedative, stimulant and toxic and medicinally it regulates blood pressure, cholesterols, hypertension etc. Celery is rich in beta-carotene, folic acid, vitamin C, magnesium,

potassium, silica, sodium, chlorophyll and fiber. The celery fruit contains 2–3% of essential oil, while the leaves 0.09–0.43% (Rożek 2007a). The content and chemical composition of the essential oil of celery and other aromatic plant species are dependent on a number of factors: genetic, ontogenetic and environmental as well as agronomic factors (fertilization, irrigation, cultivation method, and harvesting method) (Benbelaid *et al.,* 2013, Nurzyńska-Wierdak *et al.,* 2014, Aćimović *et al.,* 2015). The crop has vast diversity in their wild and local cultivated land races. The early form of celery was leafy, pungent and bitter and its use was medicinal. But, still in India celery crop is underutilized and need more breeding work for improving the traits. Knowledge about germplasm diversity and genetic relationships among breeding materials could be an invaluable aid in crop improvement strategies (Mohammadi and Prasanna, 2003). Information on genetic diversity within and among closely related crop varieties is essential for a rational use of genetic resources. The analysis of genetic variation both within and among elite breeding materials is of fundamental interest of plant breeders. Diversity based on phenological characters provides basic idea for successful breeding. Morphological traits are significantly influenced by environmental fluctuations, require plants to reach full maturity before identification, and often lack stability. Consequently, new molecular tools offer the potential for identifying genes associated with various traits, including adaptive traits, and detecting polymorphisms that cause functional genetic variations. Conventional breeding techniques, which rely on processes like crossing, back-crossing, and selection, are time-consuming. Therefore, molecular technology has gained popularity as a powerful and precise tool for raw-drug authentication and genetic identification. These molecular techniques, which detect variations in the DNA of individual plants, are particularly useful for identifying potential parental lines and assessing cultivar variability. These tools have been effectively applied to characterize genetic diversity and conduct phylogenetic analysis in numerous plant species, yielding reliable and authentic results. Unlike traditional methods based on agronomic traits or geographic origin, DNA markers provide a direct measure of genetic diversity, enabling more efficient germplasm management and facilitating crop improvement strategies by revealing differences at the DNA level (Choudhary *et al*., 2016) characterized the celery germplasm using molecular markers. These markers serve as an invaluable, direct, and efficient tool for germplasm conservation and management.

Development and notification of A-Cel-2: The variety was developed through mass selection from material collected from Kangra, Himachal Pradesh during 2010-2019. The collected material was grown in the fields of ICAR-NRCSS, Tabiji, Ajmer. The purity was maintain and selection was done based on morphological characters. Mass selection breeding approach was applied to select the lines for higher yield and quality.The A-Cel-2 variety developed by ICAR-NRCSS was proposed in institute IRC and was identified for release and notification in Rajasthan State Seed Sub- Committee for Agricultural and Horticultural Crops in 33rd meeting on date of 23August, 2019 at Jaipur (Rajasthan). Notified vide S.O.1480 (E) dated 01.04.2021for commercial cultivation under timely sown, recommended POP for all celery growing areas of Rajasthan (Table 4).

Yield and quality superiority and adaptability: In multi-location testing, the proposed variety of celery Ajmer celery -2 (A-Cel-2) gave 874.3 kg ha^{-1} average seed yield, which is 23.2% higher than check A-Cel-1 in 11 trials conducted at different locations across the Rajasthan state (Table la). A-Cel-2 is higher than in quality as compare to other varieties. Its seed content essential oil 6.74% which is 17% higher than check variety A-Cel-1 (Table 3). A-Cel-2 gave 6.23 q ha^{-1} seed yield, which is higher than the check A-Cel-1, thus having approximately 49.87% superiority over A-Cel-1 in testing at Adaptive Trial Centre, Ajmer under Govt. of Rajasthan in Zone IIIa (Table 2)

Distinguishing morphological characteristics: It can be easily identified through different DUS characters (Table.6). This variety is suitable for clay loam to sandy loam soils having good drainage facility in both kharif and rabi season. Plants are erect type, thus having resistance to lodging caused due to dew. Plant height: 125-135 cm, Maturity (range in number of days): 175-200 days.

Performance in agronomical evaluation: In normal

conditions it can be grown with recommended package of practices (POP) with 50 cm row to row distance. Variety Ajmer Celery-2 (A-Cel-2) grown with spacing 50 cm x 30 cm spacing and fertilizer application @ 80:50:50 (N: P: K) gave the highest (Table 1). Variety is lodging resistant and average yield under normal conditions is 874 kg ha^{-1}. In normal conditions it can be grown with recommended POP with 50 cm row to row distance, most suitable sowing time is 1st week of November for transplanting in Rabi. Seed rate and spacing is 2.5-3 kg ha^{-1} with 50 cm line distance (250 g for nursery raising). 4-5 irrigations are sufficient depending on soil type and climatic condition. This variety is very much desirable for cultivating under irrigated condition only.

Resistance to disease and pests*:* No infection was recorded for disease and low colonization of insect pests *viz*. aphids and *Nysus spp*.

Seed characteristics and quality: Celery seeds are very small, dark brown and emit a characteristic odour. The seeds are used as a spice in India and a condiment in the USA. The seeds give a burning sensation and are bitter. The volatile oil content of celery seeds averages 2.5 to 3.0% and it containsprimarily 60% d-limonene, 10% d-selinene, 2.5–3.0% sedanolide, 0.5% sedanomicanhydride and a fixed oil content of 15% (Farrell, 1999).

In nutshell, the high yield potential variety A-Cel-2 couples with high essential oil and no major insectpests, makes this variety a suitablechoice for the seed spices growing farmers of Rajasthan.

DNA fingerprinting of Ajmer Celery-2:DNA fingerprinting of the A-Cel-2 variety was conducted using ISSR primers (ISSR05), which generated polymorphic bands that clearly differentiated A-Cel-2 from the check variety A-Cel-1. Notably, the ISSR (Inter-simple sequence repeat) band 05400 (primer 5 with 400bp size) was present in A-Cel-2 but absent in A-Cel-1, providing a clear molecular marker distinguishing the two varieties. This molecular distinction underscores the genetic difference between the released variety and the check, further validating the development and unique characteristics of A-Cel-2 (Table 5 & Fig-1)

Table 1. Summary of performance of proposal of celery varieties in station trials conducted at different locations at NRCSS, Ajmer and PAU, Ludhiana Seed yield (Kg ha^{-1})

Particulars	Proposed entry Ajmer Celery-2 (A-Cel-2)	National check A-Cel-1
Years of testing	2010-11 to 2016-17	2014-15 to 2016-17
Total yield over the locations/year	9617.80	7805
No. Of locations/year	11	11
Mean	874.3	709.5
% increase over National check ACel-1		23.2

Table 1a. Seed yield (kg ha^{-1}) of celery varieties at different locations at NRCSS, Ajmer and PAU, Ludhiana (Punjab & Rajasthan)

Year	Trial/Location	A-Cel-2	A-Cel-1(Check)
2010-11	NRCSS, Ajmer	1065	645
2011-12	NRCSS, Ajmer	945	545
2012-13	NRCSS, Ajmer	1143	715
2013-14	NRCSS, Ajmer	977	940
2014-15	PAU, Ludhiana	894	885
2015-16	PAU, Ludhiana	511.2	737
2014-15	NRCSS, Ajmer	946	577
2015-16	NRCSS, Ajmer	1350	1096
2016-17	NRCSS, Ajmer	1163.8	1249.4
2016-17	ATC, Ajmer	622.7	415.5
		9617.8	7805
		11	11
		874.3	709.5
	% increase over check A-Cel-1		23.2

Table 2. Ancillary data for the proposed variety A-Cel-2 tested at NRCSS, Ajmer during 2010-11 to 2016-17

Characters	A-Cel-2	A-Cel-1
Plantheight (cm)	132.1	125
Primary branches/plant (Nos.)	12.7	11.0
Secondary branches/plant (Nos.)	32.8	30.0
No. of umbels/plant	270.5	255.7
No. of umbellate/umbel	26	22.8
No. of seeds/umbellate	36.7	33.4
Days to maturity	175	180
Seed yield (Kg ha^{-1})	1153.3	974.2
Test weight (g)	0.403	0.353

Table 3. Quality attributes of the proposed variety ACel-2 tested at NRCSS, Ajmer during 2010-11 and 2016-17

Quality attributes	A-Cel-2	A-Cel-1
Essential Oil (%)	6.74	5.75

Table 4. Performance of A-Cel-2 in Adaptability testing of Celery varieties at Adaptive Trial Centre, Ajmer, (Govt. Of Rajasthan, Jaipur) during 2016-17

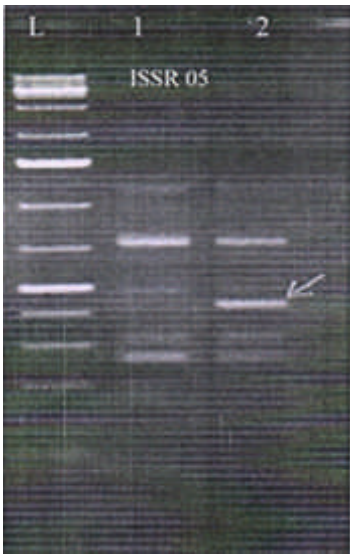
Varieties	Plant height (cm)	Seed yield (kg ha^{-1})
A-Cel-6	97.00	580.56
A-Cel-2	100.53	622.78
A-Cel-8	106.07	433.33
A-Cel-1	99.67	415.56
SEm	4.70	0.37
CD (0.05)	16.25	1.28
CV (%)	2.02	3.11

Table 5. DNA fingerprinting of Ajmer Celery-2(Allele size observed in samples)

Size (bp)	Samples	
ISSR 05	ACel-1	ACel-2
750	1	1
400*	0	1
350	1	1
250	1	1

Table 6. DUS Characteristics of the variety

S. No.	Characteristics	States
1	Cotyledon: Anthocyanin pigmentation	Present
2	Leaf: Length (First inter node) (cm)	Long (>15)
3	Leaf: Width (First inter node) (cm)	Broad (>10)
4	Leaf: Distance between first and second leaflet pairs (First internode) (cm)	Long (>3.5)
5	Leaflet: Shape of tip on margin (First inter node)	Pointed
6	Leaflet: Density of margin incision (First internode)	Dense
7	Leaflet : Spacing of lobes (First internode)	Not touching
8	Petiole: Anthocyanin pigmentation	Present
9	Petiole: Length (First internode)	Short($\leq$12)
10	Plant growth habit	Erect ($\leq$45°)
11	Nature of branch emergence	Above base of the plant
12	Angle of first primary branch	Wide (<30º)
13	Days to 50% flowering	More (>100)
14	Number of primary branches per plant	More (>8)
15	Length of first internode (cm)	Short (<6)
16	Plant height (up to the top) (cm)	Short (<115)
17	Test weight (g)	High (>0.85)



Lane L- 1 kb plus
Lane 1- A-Cel-1
Lane 2- A-Cel-2

Fig-1:DNA fingerprinting of Ajmer Celery-2

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

References:

Aćimović, M.G., Dolijanović, Ž.K., Oljača, S.I., Kovačević, D.D., Oljača, M.V. 2015. Effect oforganic and mineral fertilizers on essential oil content in caraway, anise and coriander fruits. *Acta Sci. Pol. Hortorum Cultus*, 14(1):95–103.

Benbelaid, F., Abdouna, M.A., Khadir, A., Bendahou, M. 2013. Drying effect on yield andantimicrobial activity of essential oils. *Int. J Med. Arom. Plants*, 3(1):93–101.

Choudhary, S., Meena, R.S. and Sharma, R. 2016. Bhartiya Krishi Anushandhan Patrika, 31(3):204-207.

Farrell, K.T. 1999. Spices, Condiments and Seasonings, Westport, The AVI Publishing Company, Inc. pp 60–63.

Gauri, Munawwar, Javed Ali, S., Khan., Mohd Shahid. 2015. A Review of *Apium graveolens* (Karafs) with special reference to Unani Medicine. *IAIM,* 2(1):131-136.

Mohammadi, S.A. and Prasanna, B.M. 2003. Analysis of Genetic Diversity in Crop Plants-Salient Statistical Tools and Considerations, *Crop Sci.*, 43:1235–1248.

Nurzyńska-Wierdak, R., Bogucka-Kocka, A. Szymczak, G. 2014. Volatile constituents of *Melissa officinalis* L. leaves depending on plant age. *Nat. Prod. Comm.*, 9(5):703–706.

Rożek, E. 2007a. Content of some chemicals and essential oil in leaves of leaf celery *Apiumgraveolens* L.var. secalinum Alef. *Herba Pol.*, 53(3):213–217.