AICRPS Technical Bulletin

DUS Descriptors of Coriander and their Importance in Maintenance Breeding

धनिया के डीयूएस विवरणक और रखरखाव प्रजनन में उनका महत्व

ICAR-All India Coordinated Research Project on Spices
Department of Genetics and Plant Breeding
S.K. N. College of Agriculture, Jobner
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It is essential for breeders to periodically assess varieties to ensure that their characteristics remain distinct, uniform and stable. By employing DUS descriptors, breeders can effectively monitor these attributes and take corrective measures such as preventing unwanted cross-pollination or adopting controlled breeding methods to maintain genetic purity and enhance uniformity. Thus, DUS testing serves as an indispensable tool in confirming whether a variety continues to uphold its defined standards of distinctness, uniformity and stability.

The development and release of several promising coriander varieties are the result of the dedicated and coordinated efforts of the ICAR–AICRP on Spices at Sri Karan Narendra Agriculture University, Jobner, Rajasthan. Through systematic research, rigorous evaluation and wide dissemination, the team has successfully developed and popularized eleven coriander varieties. This collaborative effort has significantly contributed to the expansion and sustainability of coriander cultivation across the country.

I heartily congratulate the Principal Investigator, AICRP on Spices, Jobner Centre and his team for bringing out this valuable technical bulletin on "DUS Descriptors of Coriander and Their Importance in Maintenance Breeding (धनिया के डीयूएस विवरणक और रखरखाव प्रजनन में उनका महत्व)." I am confident that this publication will serve as a useful reference for farmers, researchers and the scientific community dedicated to the sustainable growth and advancement of the seed spice sector.

(Dean, FC)
SKNCOA, Jobner

1. Introduction:

Seed spices are the annual crops, dried fruits or seeds of which are used as condiments. They are generally grown in low rainfall areas, with limited water requirements and low agricultural inputs as compared to other crops. Therefore, these crops are extensively grown in semi-arid and arid regions of India during *rabi* season. India is the largest producer, consumer and exporter of seed spices in the world. The seed spices are also grown in different parts of the world covering mainly Mediterranean region, India, Morroco, Russia, Poland, Romania, Guatemala, Mexico, Turkey and Argentina (Coskuner and Karababa, 2007). India is home to cultivate most of the seed spices. Every state in India grows one or more of seed spices and thus, has got the privilege to be called as the largest seed spices producing country in the world. In India, major seed spice growing belt spreads from arid to semi-arid regions covering large area in Rajasthan and Gujarat states. Arid and semi-arid regions of these two states are very conductive for growth and development of good quality seed spices. In the year 2023-24, coriander was grown in 6.04 lakh ha area with 8.37 lakh tons of production in the country. Rajasthan alone contributed 0.94 lakh ha area with 1.29 lakh tons production of coriander*(Department of Agriculture and Farmers Welfare, Govt. of India, 2023-24).*

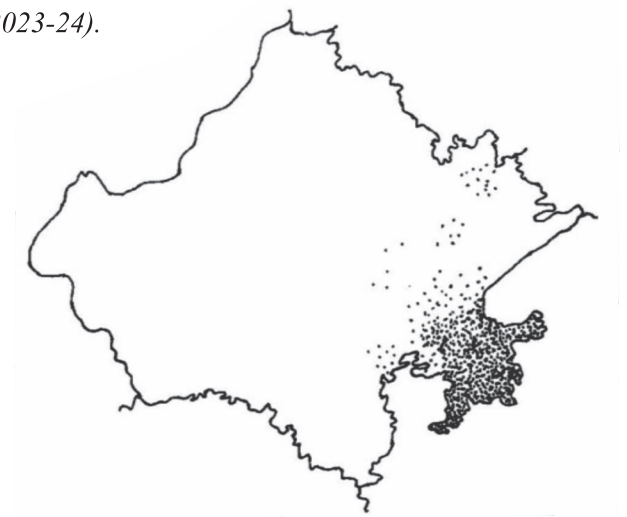


Figure 1 Coriander growing districts of Rajasthan

The major coriander growing areas in Rajasthan are Kota, Jhalawar, Baran and Bundi districts, which fall in zone V characterized with clay to clay loam soils with rainfall of 650 to 1000mm. The crop is also grown under irrigated conditions in Sikar, Jaipur, Tonk and Alwardistricts of Rajasthan which on medium light to heavy soils with rainfall below 600 mm. Botanically,

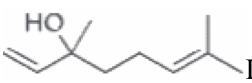
coriander (*Coriandrum sativum*L.) is an annual herb of family *Apiaceae*, commonly used as spice as well as herb for culinary purposes worldwide. Its leaves, seeds and essential oils are used in various cuisines, particularly in Asian, Middle Eastern, and Latin American dishes. Coriander is highly valued for its aromatic properties, contributing to flavor in food and medicinal uses. Corainder seeds are most common spice in curries, while the fresh leaves (often called cilantro) have a unique and pungent flavor, widely used in salads, salsas and garnishes.

The concerted efforts made by scientists of Sri Karan Narendra Agriculture University, working in ICAR-All India Coordinated Research Project on Spices, Jobner has resulted in the development 10 coriander varieties namely RCr 20, RCr 41, RCr 435, RCr 436, RCr 446, RCr 475, RCr 480, RCr 684, RCr 728 and RCr 565. The varieties are widely grown in various parts of the state and are also in high demand in the other states. Further, the research team is consistently engaged in developing coriander varieties suitable for cultivation under variable soil and environmental conditions. . The centre has a large collection of germplasm consists of 858 accessions in coriander (756 indigenous and 102 exotic) which are being used to develop new varieties with specific characteristis. This booklet is an effort to compile DUS descriptors of coriander varieties developed by ICAR-AICRP on Spices, SKN Agriculture University, Jobner.

2. Botanical description of coriander :

Coriander, scientifically known as *Coriandrum sativum* L. is an annual herb of Apiaceae family, characterized by its erect, branching stems, pinnate leaves and small, white or pale pink flowers in umbels, ultimately producing small, yellow-brown, globular fruits (seeds). It isa herbaceous plant that can attain height up to 90 cm or 120 -140 cm depending upon the agro-climatic conditions (Yasir *et al.,* 2019). Its plant is bushy in appearance with numerous branches and sub-branches adorned with small leaves used for culinary purposes. The foliage consists of oval-shaped new leaves, while the mature leaves are elongated. Flowers are white with a hint of brinjal-like shades, and the fruits are round in shape (Pathak *et al.,* 2011). Notably, the entire plant, particularly the unripe fruits, emits a strong and unpleasant odor (Shivanand, 2010). The fruit size varies among different varieties of *Coriandrum sativum* L. (Al-Snafi, 2016).Coriander herb is renowned for its aromatic fragrance and flavour. The lower leaves have broad, crenate-lobed margins, while the upper leaves are finely divided into linear lobes. The flowers are arranged in compound terminal umbels, appearing in either white or pinkish colour. The fruits are nearly globular and possess a yellow-brown schizocarp. Coriander thrives in a warm, dry summer climate with short, rainy winters, and it is commonly grown as a cold weather crop (Foudah *et al.,* 2021). The leaves are commonly known as cilantro, fresh basil, Chinese parsley, or coriander leaves. The fresh leaves are frequently used as a delicacy for soup, seafood, and traditional dishes as well as a component in curries, greens, sauce, and guacamole. Coriander leaves are frequently used uncooked or served to the meal right before dishing because heat decreases their flavour. Both the leaves' andthe seeds' flavours are different. Linalool is the major flavouring agent found in the seeds.

Taste and smell:



Linalool, a terpenoid, is a major contributor to the fragrance of coriander.

The essential oil from coriander leaves and seeds contains mixed polyphenols and terpenes, including linalool as the major constituent accounting for the aroma and flavour of coriander.

The gene OR6A2 lies within a cluster of olfactory-receptor genes and encodes a receptor that is highly sensitive to aldehyde chemicals. It has been reported that the coriander aroma is created by a half-dozen substances, most of which are aldehydes(Eriksson *et al*, 2012).

3. Phyto-constituents:

Coriander exhibits a wide range of diversity, and thus can be distinguishing into various groups. Fresh leaves and dried seeds are used in cooking, the major portions of the plant, that are used most frequently. Coriander is known to be a good source of antioxidants and can help reduce sodium intake, potentially allowing people to use less salt in their diets. Due to the presence of essential oil concentration, which varies from 0.1 to 1% in dried seeds, the fragrant fruits of coriander have a nice scent and flavor (Arora*et al,* 2021; Sharmeen*et al,* 2021). The essential oil of coriander comprises several key components, including camphor, limonene, geranial, linalool, limonene, linalylacetate, γ-terpinene, and geranyl acetate. Linalool, constituting 70% of the extract's bioactive compound, serves as a common additive in processed foods, beverages, cosmetics and household detergents, contributing to the anti-diabetic and antimicrobial effects of coriander seeds (Sarkic and Stappen, 2018).

4. DUS descriptors in coriander

DUS (Distinctness, Uniformity and Stability) descriptors are a set of criteria used to assess the unique characteristics of plant varieties, ensuring that the variety is distinct from others, uniform within its population and stable over successive generations. These descriptors are crucial in the protection of plant varieties, particularly in the registration and commercialization of new cultivars.

(i) Distinctness: A variety must exhibit characteristics that are different from existing varieties. In coriander, the distinctness may be in seed size, leaf shape, plant height, flowering traits, umbel shape,compactness etc.

(ii) **Uniformity**: A variety must be uniform in its characteristics i.e. most of the plants of a cultivar should exhibit minimal variation in traits like leaf size, flower color and growth habit. Uniformity is crucial in the spice and herb industry, as it ensures that the product from the variety remains consistent for culinary purposes.

(iii) **Stability**: A variety must demonstrate stable characteristics over time. Stability is important for ensuring that the traits that make the variety valuable, like yield potential, fragrance, essential oil content etc., do not change from one generation to the next.

5. Need for DUS descriptors:

The application of DUS descriptors is particularly important in the registration of new varieties of coriander, as it allows for the clear identification and differentiation of varieties. DUS testing can help protect intellectual property by ensuring that only those varieties that meet specific criteria are recognized as new and distinct, thus preventing the misuse or unauthorized replication of these varieties. DUS testing is an essential component of plant breeding and seed certification, designed to ensure that new varieties of crops are distinct from existing ones, uniform in their traits and stable over time. DUS descriptors are a set of standardized characteristics or traits that breeders use to differentiate between plant varieties. These descriptors are not only valuable for patenting or registering new plant varieties but are also crucial for maintaining the genetic integrity of crops over time (Kumar *et al*., 2022).

In the context of coriander, DUS descriptors typically include morphological traits such as plant height, leaf shape, fruit color, seed size, and flowering time. These traits help breeders identify a particular variety and confirm that theyremains distinct from others during subsequent generations. A variety must show unique characteristics that set it apart from existing varieties in the marketplace. Furthermore, the variety should display uniformity, meaning the plants of that variety should exhibit consistent traits when grown under similar environmental conditions. Stability is a vital trait as well, ensuring that these distinguishing features remain consistent throughout the breeding cycles and over successive generations.

The International Union for the Protection of New Varieties of Plants (UPOV) and Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA) has established guidelines for the creation of DUS descriptors for plant varieties. These descriptors are adapted to the characteristics of the specific crop in question, taking into account the particular traits that are most likely to affect the plant's identity and performance (UPOV,2013). In coriander, such descriptors cover a broad range of characteristics from the appearance of the leaves to the chemical composition of the essential oils, which are integral to the plant's commercial value.

6. DUS characterization of coriander varieties developed at SKNAU, Jobner

ICAR-All India Coordinated Research Project on Spices, SKN College of Agriculture, Jobner has been a significant player in advancing seed spices research in India. Among its various contributions, the development of high-yielding, disease-resistant varieties of coriander has been notable. Its research focuseson enhancing the agronomic traits of coriander like seed yield, essential oil content, drought tolerance and resistance to pests and diseases.

The development of coriander varieties at SKNAU, Jobneris focused on improving both the agronomic performance and the quality attributes of coriander, including seed size, yield and essential oil content. The DUS descriptors recorded for these varieties were compiled to meet the standards of seed certification processes and to ensure that each variety remains distinguishable, consistent and stable across generations. These descriptors are essential for confirming the identity of the varieties and for maintaining their commercial value. Following are the key DUS descriptors for coriander varieties developed at SKNCOA, Jobner:

1. **Plant characteristics:**

- **Plant height:** Plant height is an important descriptor for identifying coriander varieties. In the developed varieties, plant height has been carefully selected to ensure optimal space utilization in cultivation while facilitating mechanical harvesting. Varieties developed at SKNCOA show distinct differences in height, with some being medium-sized and others reaching taller growth stages.
- **Leaf shape:**Leaf shape of coriander varies across the varieties. Some varieties have broader, rounder leaves, while others feature finely divided, feathery leaves. This trait is particularly useful in distinguishing varieties that have different culinary or processing uses.
- **Leaf color:** Leaf color, often a pale to dark green, is another key descriptor used for distinguishing coriander varieties. Consistency in leaf color is an key factor in assessing the uniformity of the variety.

2. **Inflorescence and flower characteristics**

- **Flowering time:** Time taken by coriander varieties for flower is a significant descriptor in identifying distinctness. Early- to mid-season varieties, for example, may be preferred in some

regions where a quick crop turnaround is desired, while late-flowering varieties may be chosen for longer growing seasons.

- **Flower color and size:** The flower color, typically white or light pink, is a trait that varies among coriander varieties. Flower size and arrangement are also recorded in DUS descriptors, helping to differentiate between varieties with distinct blooming habits.

3. Fruit and seed characteristics

- **Seed shape and size:** One of the most significant descriptors for coriander, particularly in the commercial seed market, is seed shape and size. Varieties developed at SKKAU, Jobner have optimal seed size, which is acceptable for both culinary and medicinal purposes. Larger, uniform coriander seeds are considered better for higher essential oil content.
- **Seed color:** The color of coriander seeds varies from pale yellow to light brown. This trait helps to identify specific varieties and ensure that the seeds are uniform within a given variety.
- **Seed oil content:** Essential oil content, an important trait for both culinary and industrial uses, is also a key DUS descriptor of coriander. The coriander varieties developed at SKNCAU, Jobner show consistent oil profiles, with some varieties having exceptionally high essential oil content, which is important for industrial purposes.

4. Performance characteristics

- **Yield potential:** Yield is a critical descriptor for any crop, and coriander is no exception. Varieties developed at SKNAU are evaluated based on their ability to produce high seed yields, ensuring that the selected varieties provide good returns for farmers.
- **Disease resistance:** The resistance to common diseases such as root rot and fungal infections is an important aspect of coriander breeding. DUS testing includes the evaluation of disease resistanceto ensure yield stability of a variety under diverse growing conditions.
- **Adaptability to soil and climatic conditions:** Coriander varieties are evaluated for their adaptability to different soil types and climatic conditions. Varieties that are adaptable to both temperate and tropical environments are particularly valuable, as they can be cultivated in a range of variable climatic conditions.

7. Characteristics of coriander varieties developed at SKNAU, Jobner

Crop & description	Variety	Year of Release	Duration (days)	Av. yield (q\ha)	Characteristics
Coriander B.No : *Coriandrum sativum* L. **Ch. No. :** 2n=22 **Center of origin:** Mediterranean & Middle east region **Family:** Apiaceae **Disease:** Stem gall & Powdery mildew **Seed rate:** 10-12 kg/ha **Sowing time:** Oct. last week to Nov. I week **Test weight:** 11-13g **Economic Part:** leaf & seed	RCr-20	1996	100-110	15-16	Bushy, medium tall, bold oblong seed & stem medium thick; pink colour, early mature and suitable for heavy soil of Rajasthan
	RCr-41	1988	140-145	10-12	Tall erect type, longer juvenile period, stem thick & light to deep violet color and adapted to irrigated condition of Rajasthan
	RCr-435	2004	110-130	11-13	Bushy& erect type, early vigour is high and moderately resistant to root knot nematode suitable for all of Rajasthan
	RCr-436	2002	90-100	15-16	Bushy & semi dwarf, early mature, moderately resistant to root knot nematode and suitable for heavy soil of Rajasthan
	RCr-446	2001	110-130	12-14	Leafy and erect type, higher seeds/umbel and suitable for all the coriander growing area of country under irrigated condition
	RCr-684	1999	110-130	10-12	Tall plant type, large & bold seed suitable for all the coriander growing area of Rajasthan under irrigated as well as rainfed crop
	RCr-480	2006	110-130	13-15	Bushy and erect type, early vigour is high, medium seed and suitable for all the coriander growing area of Rajasthan under irrigated condition
	RCr-728	2010	130-140	13-15	Bushy and erect type, early vigour is high, medium seed & late mature and suitable for all the coriander growing area of country under irrigated conditions with wider adaptability and superiority
	RCr-475	2014	130-140	17-20	Bushy and erect type, early vigour is high, more umbellets& seeds/umbel and suitable for all the coriander growing area of Rajasthan under irrigated condition
	RCr-565	2024	110-120	16-20	Early maturing, bushy, erect type, early maturing, bold seed, high volatile oil, resistant to stem gall, suitable for all the coriander growing states of the country.

The development of such varieties helps farmers reduce risks associated with climate change, pest infestations and crop diseases. These varieties also allow farmers to access high yield with quality seeds and thus improve both their economic returns and the overall quality of coriander in the market.

8. Importance of DUS descriptors in maintenance breeding

Maintenance breeding is the process of ensuring that the desirable traits of a plant variety are preserved over generations. It is critical in ensuring that the variety remains true to its original characteristics, especially in the face of environmental factors and disease pressure that may lead to genetic drift. DUS descriptors play a pivotal role in maintenance breeding by providing clear benchmarks for evaluating the consistency and stability of a variety's traits. When performing maintenance breeding, breeders need to periodically test the variety to ensure that its characteristics are distinct, uniform and stable. By using DUS descriptors, breeders can track these characteristics and make necessary adjustments, such as preventing cross-pollination or introducing controlled breeding techniques to enhance uniformity.DUS testing plays an important role in this process, helping breeders to find out, whether the variety maintains its distinctness, uniformity and stability. The DUS helps in following manner in maintenance breeding of coriander.

(i) **Ensuring consistency**: Maintenance breeding ensures that the traits that make a variety valuable remain unchanged. DUS descriptors serve as a reference point for determining whether the plants are still exhibiting the same qualities that were originally intended. For example, if the essential oil content or disease resistance in a variety like RCr 41 begins to decline, maintenance breeding allows for corrective measures.

(ii) **Preserving unique traits**: The use of DUS descriptors ensures that the variety's unique characteristics are preserved. For instance, the high seed yield and aromatic quality of RCr 728 must be maintained generation after generation. DUS testing helps breeders

identify any unintended changes in the variety, which may occur due to mutation, genetic drift or cross-pollination.

(iii) **Promoting genetic integrity**: The descriptors ensure that the genetic integrity of a variety is upheld. In coriander, where the essential oil content and seed quality are key factors for success, the DUS system helps prevent any genetic degradation, which could result in lower-quality crops. This is particularly important when varieties are being used for commercial production of coriander, where yield consistency and high-quality standards are essential.

(iv) **Supporting market value**: For newly developed varieties, DUS testing and maintenance breeding help to preserve their commercial value. If a variety loses its unique traits over time, it may become indistinguishable from other varieties, leading to market confusion and loss of farmer trust. DUS descriptors ensure that the variety continues to stand out, retaining its position in the market.

a. **Supporting Intellectual Property Protection**: DUS descriptors play a crucial role in the protection of new varieties under plant variety protection laws. By providing a clear, standardized method of assessing a variety's distinctness, uniformity and stability, DUS testing helps safeguard the intellectual property of new coriander varieties. This ensures that breeder' innovations are legally recognized and protected, preventing unauthorized replication of their work.

b. **Ensuring distinctness and identity preservation**

One of the primary goals of maintenance breeding is to maintain the identity of a variety over generations. DUS descriptors help breeders confirm that the unique characteristics of a particular coriander variety remain intact. For instance, coriander varieties may differ in leaf shape, seed color, or essential oil composition. These traits must be reliably passed down through successive generations. If there are inconsistencies or variations in these characteristics, it could signal genetic drift or contamination from cross-pollination. DUS testing helps breeders identify such issues early and take corrective actions to preserve the distinctness of the variety.

c. **Ensuring uniformity**

In addition to distinctness, uniformity is another key aspect of maintenance breeding. Uniformity refers to the consistency of the plant's traits when grown under the same environmental conditions. For coriander, uniformity ensures that all plants within a variety

exhibit the same growth habit, seed size and essential oil content. This consistency is important not only for breeders but also for farmers and the market. Uniformity reduces the risk of producing seeds with varying qualities, which can undermine consumer confidence and disrupt market supply. DUS descriptors help monitor uniformity, ensuring that the variety continues to perform consistently from year to year.

d. **Ensuring stability**

Stability is another crucial element of maintenance breeding. Over time, a plant variety must be stable in terms of its physical and chemical traits, meaning that its key characteristics should not change or revert to undesirable forms. In coriander, instability could result in variations in seed size or flavor, which could have significant implications in the market. Breeders must ensure that the variety remains genetically stable through successive generations. DUS descriptors play a key role in monitoring these traits to ensure that they are inherited consistently, preventing the accidental loss or alteration of important characteristics.

e. **Managing genetic diversity and avoiding deleterious traits**

While maintaining the desirable traits of a variety, maintenance breeding also ensures that genetic diversity is managed appropriately. In case of coriander, breeders must balance the need for uniformity and stability with the importance of avoiding inbreeding depression, which can lead to a loss of vigor and resilience in the plants. DUS testing, by its very nature, helps breeders monitor genetic stability and identify any unintended genetic drift or loss of vigor that may occur during the maintenance process.

9. Guidelines for conducting DUS testing of coriander

Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA), Ministry of Agriculture and Farmers Welfare, Govt. of India has suggested following guidelines for conducting DUS testing in coriander.

(i) **Subject:** These test guidelines shall apply to all varieties/parental lines/ hybrids of Coriander (*Coriandrum sativum* L.)

(ii) **Seed material required :**

- The Protection of Plant Varieties and Farmers's Right Authority (PPV&FRA) shall decide when, where and in what quantity and quality of the seed material are required for testing a variety denomination applied for registration under the Protection of Plant Variety and Farmer's Rights (PPV& FR) Act, 2001. Applicants submitting such seed material from a country other than India shall make sure that all customs and quarantine requirements stipulated under relevant national legislations and regulations are complied with. The minimum quantity of the seed to be provided by the applicant shall be 250 g. Each of these seed lots shall be packed, sealed properly labeled with details in ten equal weighing packets and submitted in one lot. Parental lines should be packed separately in one packet
- The seed submitted shall have at least 80% germination, 98% physical purity, highest genetic purity, uniformity, sanitary and phyto-sanitary standards. In addition, the seed moisture content shall not exceed 8-9% to meet the safe storage requirement. The applicant shall also submit along with the seed a certified data on germination test made not more than one month prior to the date of submission.
- The seed material submitted shall not have been subjected to any chemical or biophysical treatment.

(iii) Conduct of test

- The minimum duration of the DUS tests shall normally be at least two independent similar growing seasons.
- The test shall normally be conducted atleast at two test locations. If any essential characteristics of the candidate variety are not expressed for visual observation at these

locations, the variety shall be considered for further examination at another appropriate test site or under special test protocol on expressed request of the applicant.

- The field test shall be carried about under conditions favoring normal growth and expression of all test characteristics. The size of the plot shall be such that plants or parts of plants could be removed for measurement and observation without prejudicing the other observation on the standing plants until the end of the growing period. Each test shall include about 500 plants, in the plot size and planting space specified below across three replications. Separate plots for observations and for measurement can only be used if they have been subjected to similar environmental conditions. All the replications shall be sharing similar environmental conditions of the test locations.

(iv) Test Plot Design

Number of rows	06
Row length	2m
Row to row distance	50cm
Plant to plant distance	20cm
Number of replications	03
Expected plants/replication	200

Note : Observation should not be recorded on plants in border rows

(v) Methods and observations

- The characteristics described in the table of characteristics shall be used for the testing of variety/pure lines/hybrids for their DUS.
- For the assessment of Distinctiveness and Stability, observations shall be made on 30 plants or parts of plants, which shall be equally divided among 3 replications (10 plants per replications).
- For the assessment of Uniformity of characteristics on the plot as a whole (visual assessment by a single observation of a group of plants or parts of plants), a population standard of with, an acceptance probability of at least 95% should be applied. In a sample size of 100 plants, the number of off type plants allowed shall not exceed 5%.

- ❖ All observations on growth habit shall be made at the time of appearance of king umbel. (Excluding basal leaf)
- ❖ All the observation on seedcharacteristics shall be made on harvested dry seeds.
- ❖ For the assessment of all colour characteristics, the latest Royal Horticultural Society (RHS colour chart) shall be used.

(vi) Grouping of varieties based on characters

- ❖ The candidate varieties for DUS testing shall be divided into groups to facilitate the assessment of Distinctiveness. Characteristics, which are known from experience not to vary, or to very only slightly within a variety and which in their various states are fairly evenly distributed across all varieties in the collection are suitable for grouping purposes.
- ❖ The following characteristics shall be used for grouping of coriander varieties.

- Number of basal leaves
- Length of longest basal leaf
- Growth habit
- Involucer
- Seed per umbel
- Umbellates per umbel
- 1000 -seed weight
- Seed shape

(vii) Characteristics and symbols

a. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the table of characteristics shall be used.

b. Note (1 to 9) shall be used to describe the state of each character for the purpose of digital data processing and this note is given against the states of each characteristic.

c. Legend

(*) Characteristics that shall be observed during every growing season on all varieties and shall always be included in the description of the variety, exceptwhen the state of expression of any of these characters is rendered impossible by preceding phenological characteristics or by the environmental conditions of the testing region. Under such exceptional situation, adequate explanation should be provided.

(+) See Explanations on the Table of characteristics. It is to be noted that for certain

characteristics, the plant parts on which observation to be taken are given in the explanation of figure(s) for clarity and not the colour variation.

d. A decimal code number in the sixth coloumn of table of characteristics indicates the optimum stage of observation of each characteristic during the growth and development of plant. The relevant growth stages corresponding to those decimal codes numbers are described below:

(viii) Decimal code for the growth stages

DecimalCode	GrowthStage
10	At the initiation of flowering
20	Anthesis on main umbel
30	Full bloom of main umbel
40	At time of main umbel maturity
50	At time of maturity
60	After the harvesting and drying of mature seed

(ix) Type of assessment of characteristics indicated in column seven of Table of characteristics is as follows:

MG: Measurement by a single observation of a group of plants or parts of plants

MS: Measurement of a number of individual plants or parts of plants

VG: Visual assessment by asingle observation of agroup of plants or parts of plants

VS: Visual assessment byo bservation of individual plants or parts of plants

(x) Table ofCharacteristics

S.No.	Characteristics	States	Note
1	2	3	4
1. (*) (+)	No. of basal leaves	Low (1-3) Medium (4-6) High (>6)	3 5 7
2. (*) (+)	Length of the Longest basal Leaf	Short (<6 cm) Medium (6-10 cm) Long (>10 cm)	3 5 7
3. (*) (+)	Habitus of basal Leaves	Very flatorprostrate Raised with anarcusof 45° Very erect	3 5 7
4. (*) (+)	Leaf Luster of longest basal leaf	Non Shiny Shiny	3 5
5.	Leaf margin of longest basal	Deeply Serrated	3

(*) (+)	leaf	Serrated	5
6. (*)	Leaf colour of longest basal leaf	Green Dark Green	3 5
7.	Stem Colour(Pigmentation)	Absent Present	1 9
8. (+)	Nodal Pigmentation	Absent Present	1 9
9. (*) (+)	Involucer	Absent Present	1 9
10. (*) (+)	Growth habit	Erect Semi- erect Spreading	3 5 7
11. (*)	Primary Branches(Nos)	Less (<3) Medium (4-6) More (>6)	3 5 7
12. (*) (+)	Angle of Primary branch	Narrow (<35°) Medium (35°-40°) Wide (>40°)	3 5 7
13.	Secondary Branches	Less (<20) Medium (21-30) More (>30)	3 5 7
14.	Angle of Secondary branch	Narrow (<35°) Wide (>35°)	3 5
15.	Plant height (Up to top)	Short (<30cm) Medium (31-40cm) Tall (>40cm)	3 5 7
16. (*) (+)	Umbellate per umbel	Low (<4) Medium (4-5) High (>5)	3 5 7
17. (*) (+)	Seeds per Umbellate	Average (<5) Good (>5)	3 5
18. (*)	(weightof1000 seeds at 7-8 % moisture content)	Low (<15g) Medium(15-20g) High(>20g)	3 5 7
19. (*)	SeedColour	Light- brown Ablong Oval	3 5 7
20. (*) (+)	Seed Shape	Slightly Round Ablong Oval	3 5 7

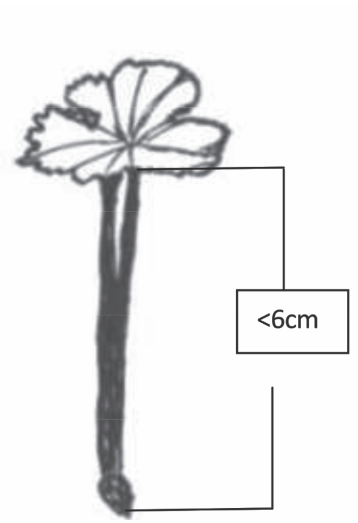
(x) Explanations of Table of characteristics

Characteristic1.Number of basal leaves

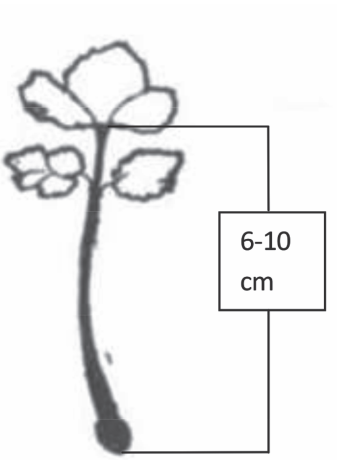
3 Low

High 7

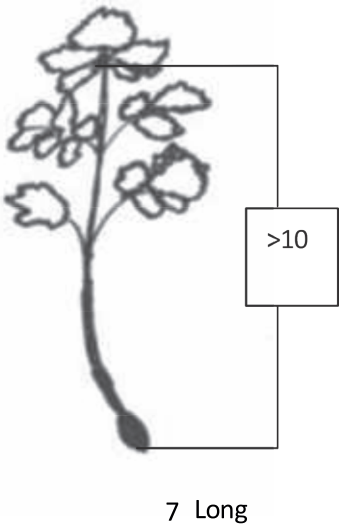
Characteristic 2. Length of the longest basal leaf



3 Short

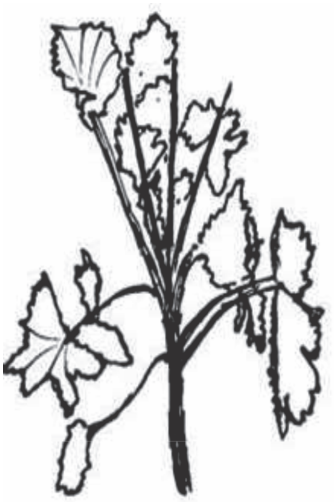


5 Medium



7 Long

Characteristic3. Habitus of basal leaves:



3 Very flat or prostrate

5 Raised an arc of 45^0

7 Very erect

Characteristic 5. Leaf margin of longest basal leaf:

3 Deeply Serrated

5 Serrated

Characteristic 8. Nodal pigmentation

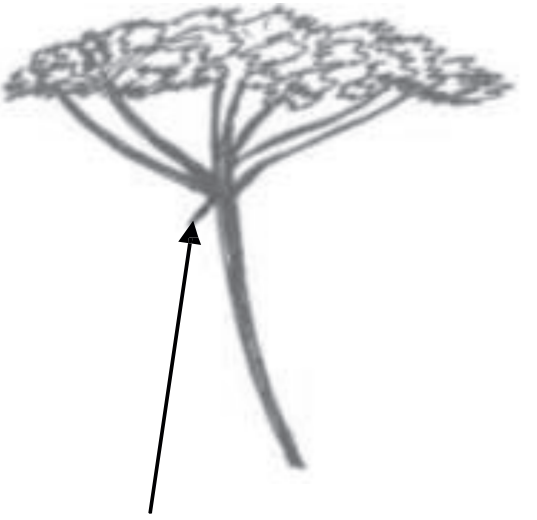
1

9

Absent Present

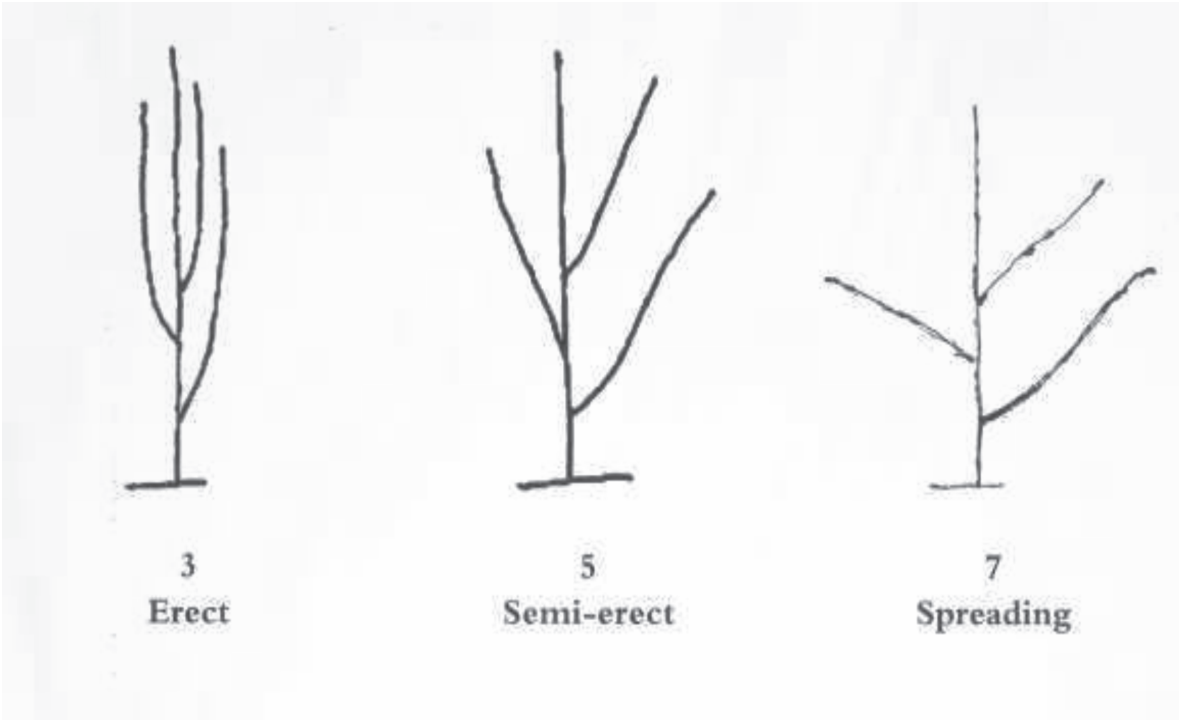
Characteristic9.Involucer:

1 Absent



9 Present

Characteristic10.Growth habit



Characteristic 12. Angle of primary branches

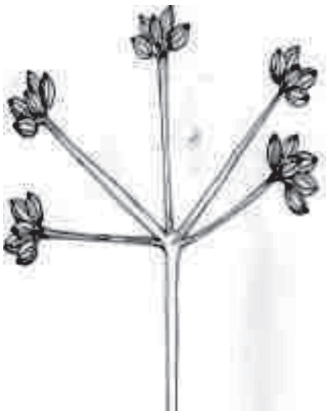
3 Narrow 5 Medium 7 Wide

Characteristic 16.Umbellates per umbel

3

Low

5



Medium

7

High

Characteristic 17. Seeds per umbellate

3

Average

5

Good

Characteristic 20. Seed Shape

3

Slightly Round

5

Ablong

7

Oval

10.Variety wise DUS descriptors of coriander

Name of Variety: RCr-20

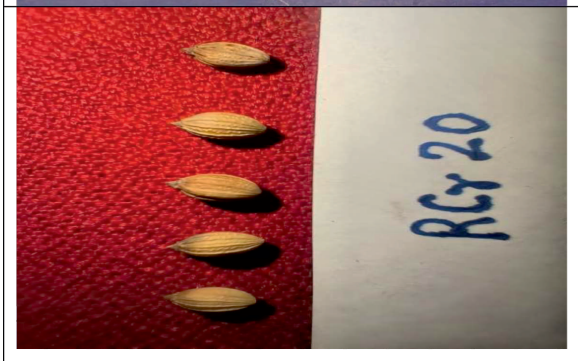
S.No.	Character	Status
1.	Number of basal leaves	Medium (4-6)
2.	Length of the longest basal leaf	Medium (6 -10 cm)
3.	Habitus of basal leaves	Raised with an arcus of 45
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Deeply serrated
6.	Leaf colour of longest basal leaf	Dark green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Less (<3)
12.	Angle of primary branch	Narrow (<35 degree)
13.	Secondary branches	Medium (21-30)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Medium tall (31-40 cm)
16.	Umbellates per umbel	Medium (4-5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	Medium (15 -20g)
19.	Seed colour	Light brown
20.	Seed shape	Oblong

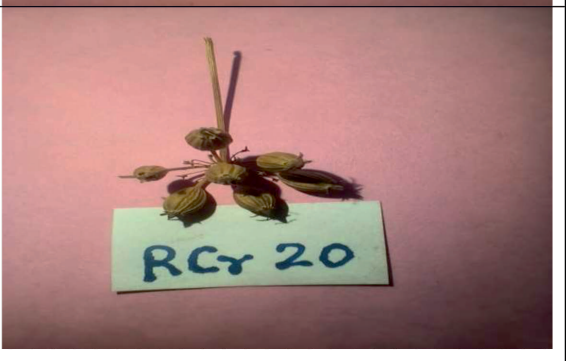

RCr-20


RCr-20


RCr-20


RCr 20


RCr 20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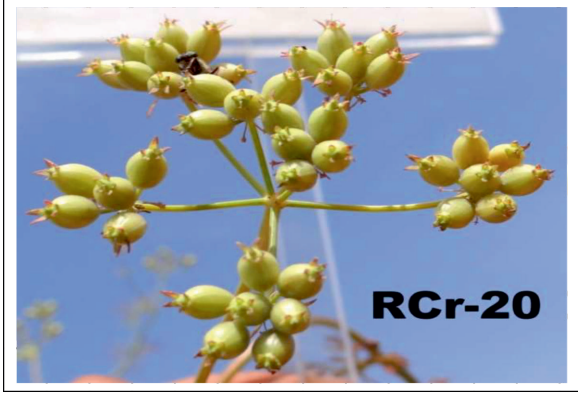

RCr-20


RCr-20

Name of Variety: RCr-41

S.No.	Character	Status
1.	Number of basal leaves	Low (1-3)
2.	Length of the longest basal leaf	Long (>10 cm)
3.	Habitus of basal leaves	Very flat or prostrate
4.	Leaf luster of longest basal leaf	Shiny
5.	Leaf margin of longest basal leaf	Deeply serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Absent
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Medium (4-6)
12.	Angle of primary branch	Wide (>40 0)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Narrow
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	High (>5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	Medium(15 -20g)
19.	Seed colour	Light brown
20.	Seed shape	Oval


RCr-41


RCr-41


RCr-41


RCr-41


RCr 41


RCr 41


Coriander
Var.
RCr-41

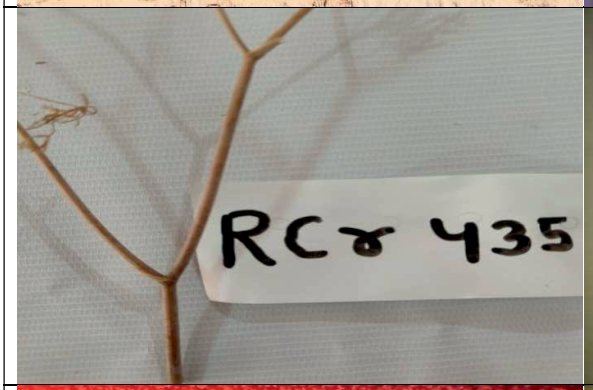

RCr-41

Name of Variety: RCr-435

S.No.	Character	Status
1.	Number of basal leaves	Medium (4-6)
2.	Length of the longest basal leaf	Medium (6 -10 cm)
3.	Habitus of basal leaves	Very flat or prostrate
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Dark green
7.	Stem colour (Pigmentation)	Absent
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Less (<3)
12.	Angle of primary branch	Medium (36 -40degree)
13.	Secondary branches	Medium (21-30)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	High (>5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Lightbrown
20.	Seed shape	Oval


RCr-435


RCr-435

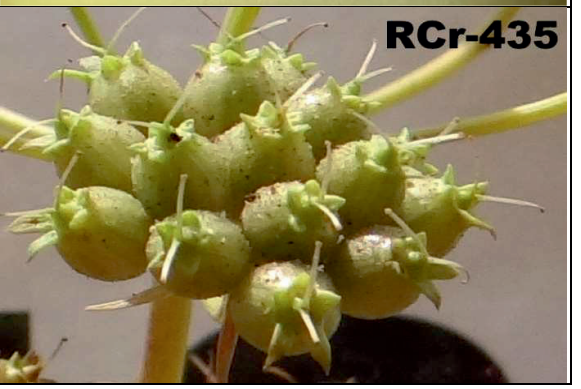

RCr 435


RCr 435


RCr 435


RCr 435


435

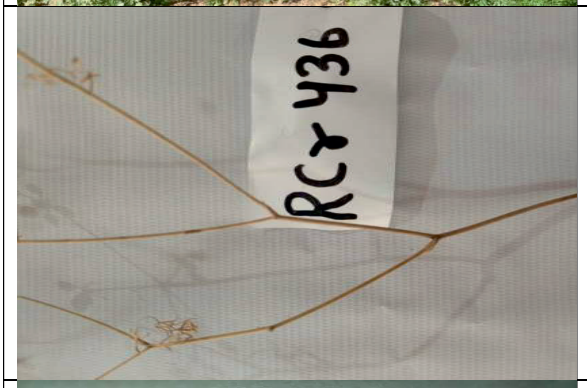

RCr-435

Name of Variety: RCr-436

S.No.	Character	Status
1.	Number of basal leaves	Less(1-3)
2.	Length of the longest basal leaf	Short (<6cm)
3.	Habitus of basal leaves	Very flat or prostrate
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Deeply serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Absent
10.	Growth habit	Semi-erect
11.	Primary branches (Nos)	Less (<3)
12.	Angle of primary branch	Narrow (<35 degree)
13.	Secondary branches	Medium (21-30)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Semi-dwarf (>40cm)
16.	Umbellates per umbel	Medium (4-5)
17.	Seeds per umbellate	Average(<5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	Medium(15 -20g)
19.	Seed colour	Lightbrown
20.	Seed shape	Oblong


RCr-436


RCr-436


RCr 436


RCr 436


RCr 436


RCr 436


RCr-436

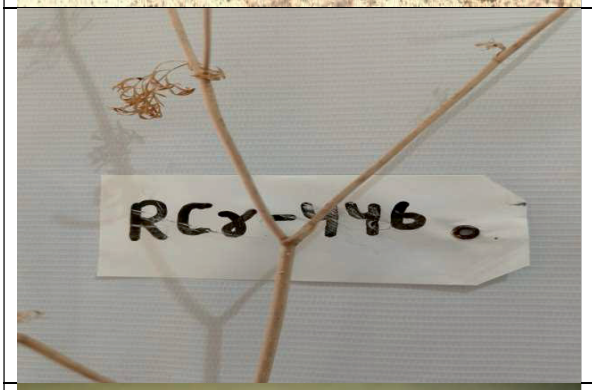

RCr-436

Name of Variety: RCr-446

S.No.	Character	Status
1.	Number of basal leaves	Medium (4-6)
2.	Length of the longest basal leaf	Long (>10 cm)
3.	Habitus of basal leaves	Very flat or prostrate
4.	Leaf luster of longest basal leaf	Non Shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Medium (4-6)
12.	Angle of primary branch	Medium (36 0 -40 0)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Medium (31-40 cm)
16.	Umbellates per umbel	High (>5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Lightbrown
20.	Seed shape	Oblong


RCr-446


RCr-446

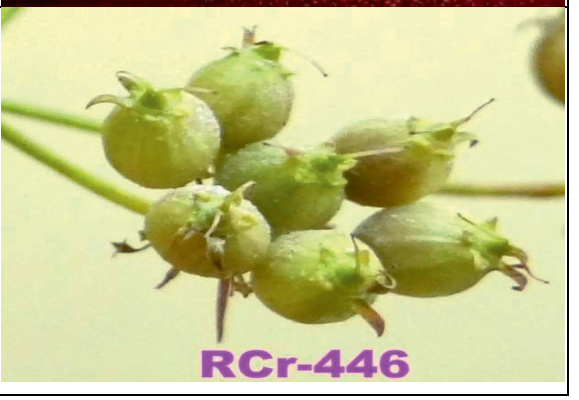

RCr-446


RCr446


RCr446


RCr446


RCr-446

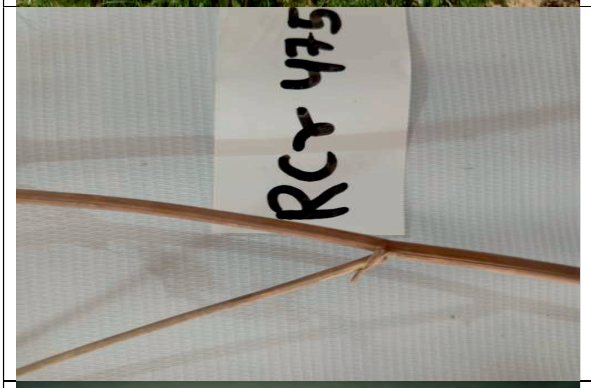

RCr-446

Name of Variety: RCr-475

S.No.	Character	Status
1.	Number of basal leaves	Medium (4-6)
2.	Length of the longest basal leaf	Long (>10 cm)
3.	Habitus of basal leaves	Raised with an arcus of 45
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Absent
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Less (<3)
12.	Angle of primary branch	Medium (36 -40degree)
13.	Secondary branches	Medium (21-30)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	High (>5)
17.	Seeds per Umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Brown
20.	Seed shape	Oblong


RCr-475

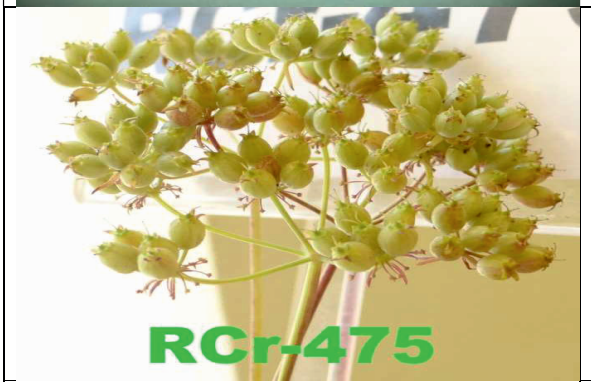

UD-475


RCr 475


RCr 475


RCr 475


RCr 475


RCr-475


RCr-475

Name of Variety: RCr-480

S.No.	Character	Status
1.	Number of basal leaves	High (> 6)
2.	Length of the longest basal leaf	Medium (6 -10 cm)
3.	Habitus of basal leaves	Raised with an arcus of 45
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Medium (4-6)
12.	Angle of primary branch	Medium (36 0 -40 0)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Medium (31-40 cm)
16.	Umbellates per umbel	High (>5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Brown
20.	Seed shape	Slightly round


RCr-480
RCr-480
RCr 480
RCr 480
RCr 480
RCr-480

Name of Variety: RCr-684

S.No.	Character	Status
1.	Number of basal leaves	High (> 6)
2.	Length of the longest basal leaf	Medium (6 -10 cm)
3.	Habitus of basal leaves	Raised with an arcus of 45
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Dark green
7.	Stem colour (Pigmentation)	Absent
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Less (<3)
12.	Angle of primary branch	Narrow (<35 degree)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	Low (<4)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	Medium(15 -20g)
19.	Seed colour	Light brown
20.	Seed shape	Oval


RCr-684
RCr-684
RCr 684
RCr 684
RCr 684
RCr 684
RCr-684
RCr-684

Name of Variety: **RCr-728**

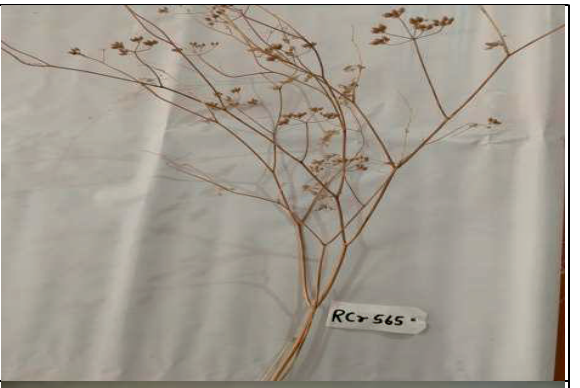
S.No.	Character	Status
1.	Number of basal leaves	Medium (4-6)
2.	Length of the longest basal leaf	Long (>10 cm)
3.	Habitus of basal leaves	very erect
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Deeply serrated
6.	Leaf colour of longest basal leaf	Dark green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Erect
11.	Primary branches (Nos)	Medium (4-6)
12.	Angle of primary branch	Narrow (<35 degree)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Narrow (<35 degree)
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	Medium (4-5)
17.	Seeds per umbellate	Good (>5)
18.	Weight of 1000 seeds (at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Brown
20.	Seed shape	Slightly round


RCr-728
RCr-728
RCr-728
RCr-728
RCr-728
RCr 728
RCr-728
RCr-728

Name of Variety:RCr- 565

S.No.	Character	Status
1.	Number of basal leaves	Low (1-3)
2.	Length of the longest basal leaf	Medium (6 -10 cm)
3.	Habitus of basal leaves	very erect
4.	Leaf luster of longest basal leaf	Non shiny
5.	Leaf margin of longest basal leaf	Serrated
6.	Leaf colour of longest basal leaf	Green
7.	Stem colour (Pigmentation)	Present
8.	Nodal pigmentation	Present
9.	Involucer	Present
10.	Growth habit	Semi-erect
11.	Primary branches (Nos)	More (>6)
12.	Angle of primary branch	Medium (36 0 -40 0)
13.	Secondary branches	Less (<20)
14.	Angle of secondary branch	Wide (>35 0)
15.	Plant height (Up to top)	Tall (>40cm)
16.	Umbellates per umbel	Medium (4-5)
17.	Seeds per umbellate	Good (>5)
18.	(weight of 1000 seeds at 7-8 % moisture)	High (>20 g)
19.	Seed colour	Brown
20.	Seed shape	Oval

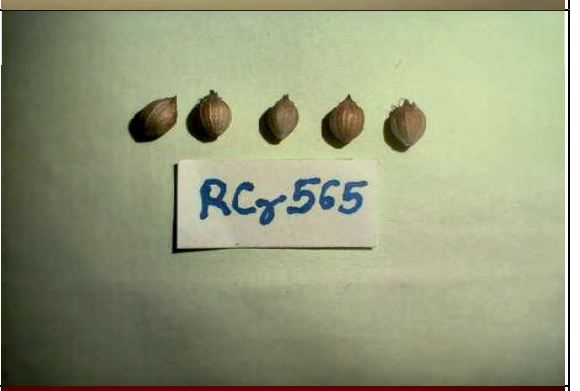

RCr-565


RCr 565


RCr-565

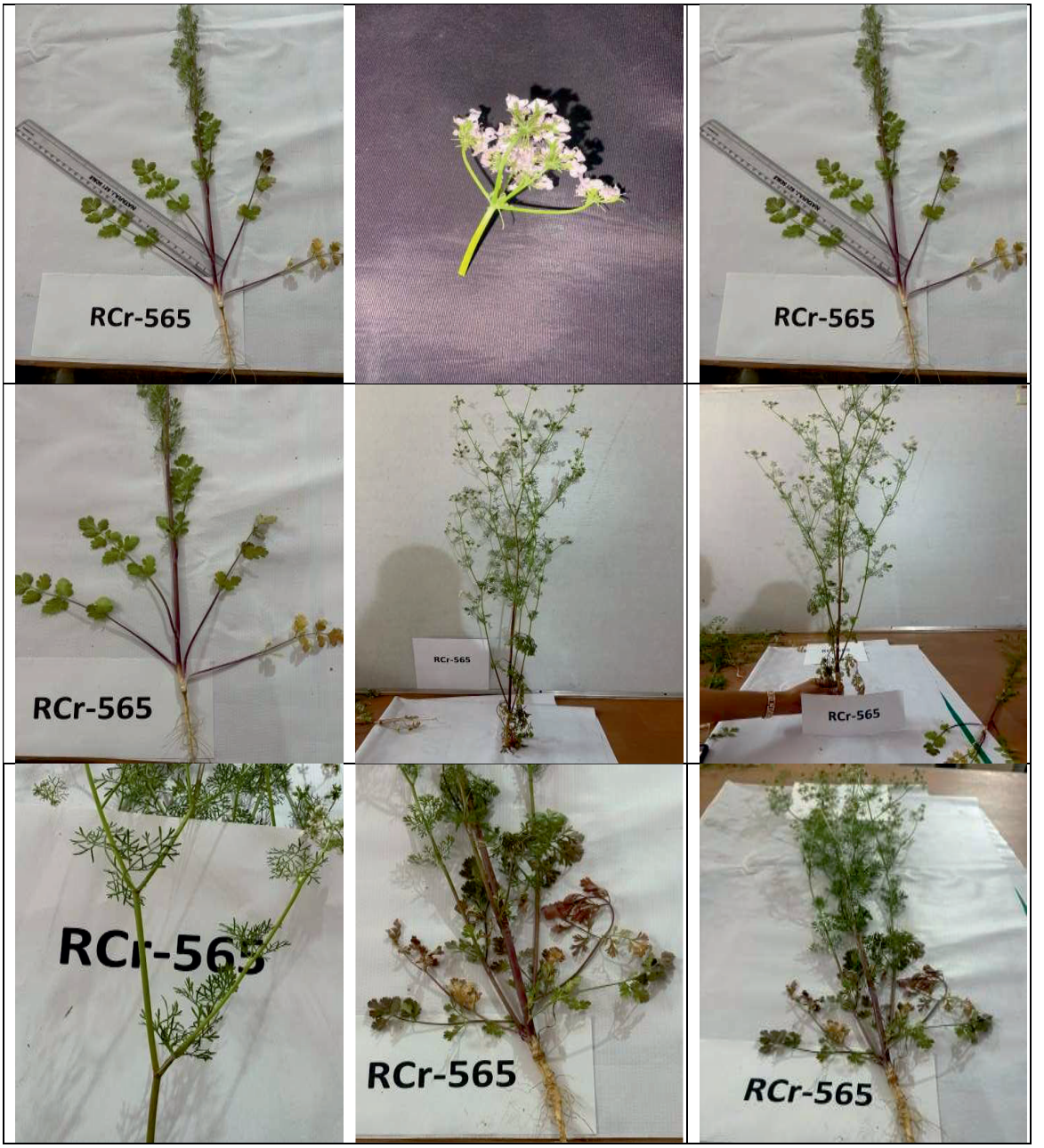

RCr565


RCr565


RCr565


RCr-565


RCr 565 (UD 565)


RCr-565
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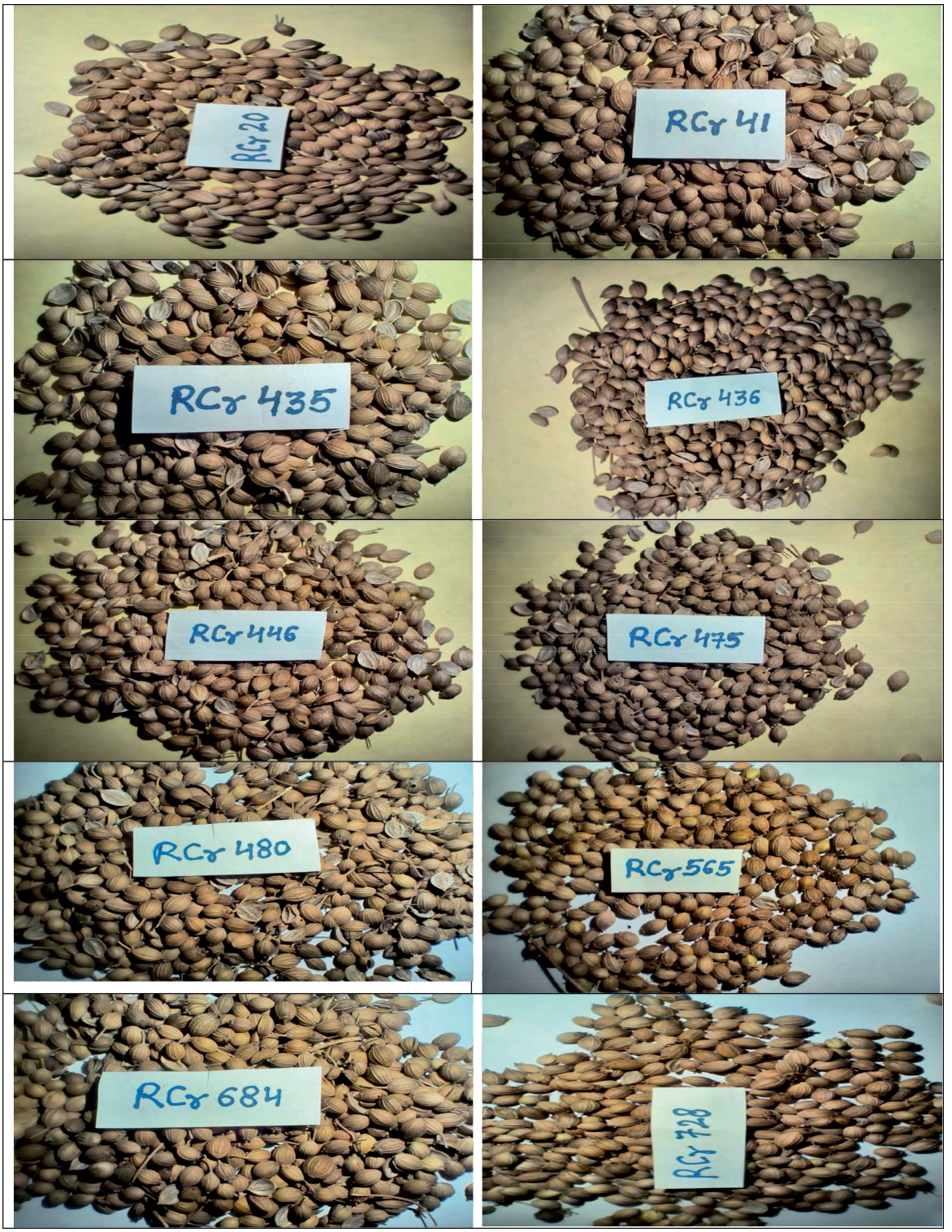
RCr-565

Fig: pictures depicting flowers of various varieties of coriander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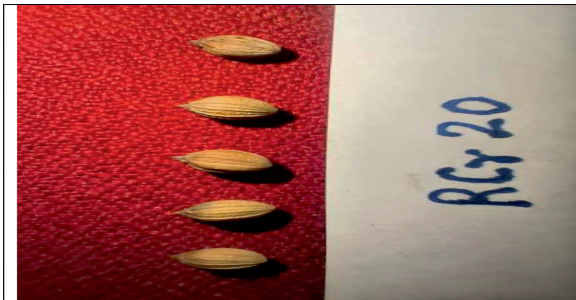
RCr 41
RCr 435
RCr 436
RCr 446
RCr 475
RCr 480
RCr 565
RCr 684
RCr 728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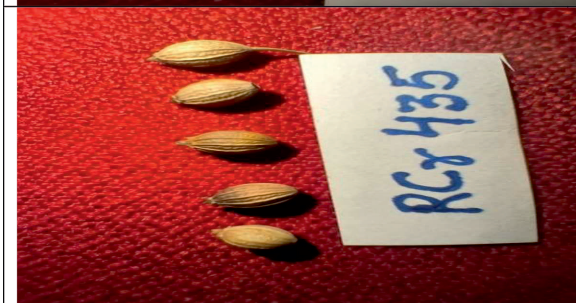
RCr 435

RCr 436

RCr 446

RCr 475

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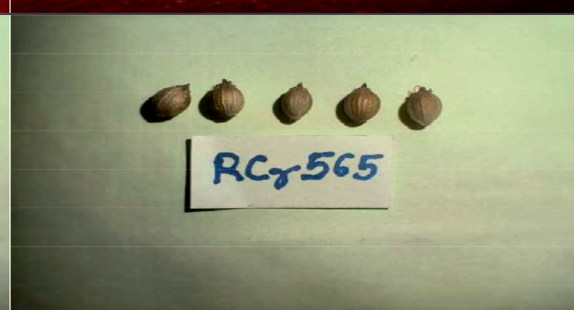
RCr 565

RCr 684

RCr 728

11. Conclusion:

Coriander is an important seed spices which plays an essential role in culinary and medicinal industries. Therefore, development of high-quality, diseaseresistant coriander varieties is crucial for ensuring sustainability in its cultivation. Research at ICAR-AICRP on Seed Spices, SKN Agriculture University, Jobner research has contributed significantly in developing coriander varieties which are able to cater the need of farmers and industrialists in terms of yield stability, disease resistce. climatic adaptability and essential oil content. DUS descriptors are an integral part of the breeding process, ensuring that new and existing varieties remain distinct, uniform and stable. In maintenance breeding, these descriptors are essential in preserving the qualities that make a variety desirable, ensuring that coriander production remains viable, profitable and of high quality for years to come. The DUS testing depicted that all the coriander varieties developed at SKNAU, Jobner are distinct from each other for different plant, leaf, flower and quality traits. It is recommended that this descriptor can be used as reference variety/material for protection of other coriander varieties under PPV& FR Act, 2001.

12. Acknowledgements

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Finally, the Principal Investigator expresses sincere appreciation to all those, named and unnamed, whose direct or indirect contributions have helped bring this booklet to fruition.

13. References

Al-Snafi, A. E. 2016. A review on chemical constituents and pharmacological activities of *Coriandrum sativum.IOSR Journal of Pharmacy*, **6**(7) :17-42.

Arora, V., Adler, C., Tepikin, A., Ziv, G., Kahane, T., Abu-Nassar, J., Golan, S., Mayzlish-Gati, E., andGonda, I. 2021. Wild coriander: An untapped genetic resource for future coriander breeding. *Euphytica*, **217**:1–11

Department of Agriculture and Farmers Welfare, Govt. of India, 2023-24. *https://agriwelfare.gov.in*

Banerjee, A. 2020. Complete guide to coriander farming: Varieties, climate requirement, harvesting, yield and economics. *AGRIPEDIA*, September 2020.

Chithra, V., and Leelamma, S. 1999.*Coriandrum sativum* changes the levels of lipid peroxides and activity of antioxidant enzymes in experimental animals. *Indian Journal of Biochemistry & Biophysics*, **36**:59–61.

Coskuner, Y., and Karababa, E. 2007. Physical properties of coriander seeds (*Coriandrum sativum* L.). *Journal of Food Engineering*, **80**:08–416.

Foudah, A. I., Alqarni, M. H., Alam, A., AymanSalkini, M., Ibnouf Ahmed, E. O., and Yusufoglu, H. S. 2021. Evaluation of the composition and in vitro antimicrobial, antioxidant, and anti-inflammatory activities of Cilantro (*Coriandrum sativum* L. leaves) cultivated in Saudi Arabia (Al-Kharj). *Saudi Journal of Biological Sciences*, **28**(6):3461–3468.

Kumar,S., Lamba, M. and Yadav,L,P. 2022. Characterization of Coriander (*Coriandrum sativum* L.) genotypes based on floral traits.*Current Horticulture,* **10** (2):56-58.

Kassu, K. T., Dawit, H. H., Wubengeda, A. Y., Almaz, A. T., and Asrat, M. T. 2018. Yield and yield components of coriander under different sowing dates and seed rates in tropical environment. *Advances in Horticultural Science*, **32**(2):193–203.

Eriksson,N.,Wu,S., Do,C.B., Kiefer,A,K., Tung,J,Y., Mountain,J,L., Hinds,D,a., and Francke,U.2012. A genetic variant near olfactory receptor genes influences cilantro preferences. *Flavour,* **1**:22.

Protection of Plant Varieties and Farmer's Rights Authority (PPV&FRA), Govt. of India.*https://plantauthority.gov.in*

International Union for the Protection of New Varieties of Plants(UPOV) ,2013. https://www.upov.int

Pathak, N. L.,Kasture, S. B., Bhatt, N. M., and Rathod, J. D. 2011. Phytopharmacological properties of Randiadumetorum as a potential medicinal tree: An overview. *Journal of Applied Pharmaceutical Science*, **1**(10):24–26

Sarkic, A., and Stappen, I. 2018.Essential oil and their single compounds in cosmetics- A critical review.*Cosmetics*, **5**(1):11.

Sharmeen, J. B., Mahomoodally, F. M., Zengin, G., and Maggi, F. 2021. Essential oil as natural sources of fragrance compounds for cosmetics and cosmeceuticals. *Molecules*, **26**(3):666.

Shivanand, P. 2010. *Coriandrumsativum*: A biological description and its uses in the treatment of various diseases. *International Journal of Pharmacy and Life Sciences*, **1**(3):119–126.

Yasir, M., Khanam, T., andHafeel, M. H. M. 2019. A review on Kishneez (*Coriander sativum* Linn): A potential herb. *The Pharma Innovation Journal,***8**(9):503– 506.