www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 4080-4084

www.thepharmajournal.com
Received: 02-05-2022
Accepted: 06-06-2022

Vinod Sahu
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Keerti Tantwai
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Nishi Mishra
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Prakash N Tiwari
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Swapnil Sapre
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Gyanendra Tiwari
Department of Plant Physiology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Sharad Tiwari
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Corresponding Author
Keerti Tantwai
Biotechnology Centre, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, India

Morphological characterization of *Curcuma caesia* germplasm collected from different regions of Madhya Pradesh

Vinod Sahu, Keerti Tantwai, Nishi Mishra, Prakash N Tiwari, Swapnil Sapre, Gyanendra Tiwari and Sharad Tiwari

Abstract
Curcuma caesia Roxb. belongs to the Zingiberaceae family, an important untouched medicinal plant commonly named black turmeric due to its bluish-black rhizome. It is a non-permeable, straightforward rhizomatous condiment with large leaves. Fresh sweet rhizomes with a strong camphoraceous scent planted by their rhizomes are used in traditional medicine. The pharma sector has its massive demand due to its phytochemicals like camphor, ar-turmerone, (Z) - ocimene, ar- curcumene, 1, 8- cineole, elemene, borneol, bornyl acetate and curcumen. These are used in therapeutics like antifungal exertion, anti-asthmatic, smooth muscle relaxant, antimicrobial exertion, antioxidant exertion, analgesic, locomotor depressant, anticonvulsant and muscle relaxant, and anti-inflammatory parcels. In this study, different accessions of black turmeric were collected, and their morphological characterization was undertaken to assess the variability that can facilitate better selection for its improvement.

Keywords: *Curcuma caesia*; rhizome, morphological characterization, black turmeric

Introduction
Curcuma caesia (Roxb.) is an important species used by various tribal communities long before. It is a perennial, medicinal rhizomatous herb belonging to the Zingiberaceae family, commonly named black turmeric and *Kali Haldi* due to its bluish-black rhizome (Baghel *et al*., 2013). Further, it is divided into undergone large ovoid tuberous rhizome and an erect aerial shoot along with leaves and reproductive parts. The plant is distributed in India, Bangladesh, China, Nepal, Malaysia and Thailand (Karmakar *et al*., 2011) [3] and is native to Northeast and Central India. *C. caesia* is endangered in South-Eastern Asia (Liu *et al*., 2013). Due to its vast medicinal use since ancient times, people have been exploiting this plant by using it in traditional medicines to cure various diseases (Sahu *et al*., 2016; Paw *et al*., 2020) [7, 5].
The rhizome of kali haldi has a huge demand and importance in the medical health and industrial pharma sector because of its medicinal properties. The bioactive compounds of rhizome extracts are used to treat human health, such as smooth muscle relaxant activity, haemorrhoids, leprosy, asthma, cancer, epilepsy, fever, vomiting, menstrual disorder, anthelmintic, aphrodisiac, inflammation, gonorrheal discharges etc.
The shape of the rhizome varies with the external surface bearing root scars, adventitious type root, and warts. Moreover, the rhizome is characterized by longitudinal circular wrinkles on the surface, giving rise to nodal and internodal zones. The rhizome is the propagation material of the plant, and it grows in subtropical to temperate regions, in sandy loam, and acidic soils of pH 4.5–6.5. A massive variation in rhizome makes it challenging to identify; hence, a study is necessary to determine the black turmeric properties, including morphological characteristics, growth, and yield components. This study aims to characterize different germplasms of black turmeric to potential as breeding materials for developing superior varieties.

Materials and Methods
The plant materials used in the study were healthy rhizomes of black turmeric collected from different regions of Madhya Pradesh (Fig. 1). The collected germplasm is being maintained and conserved at Biotechnology Centre JNKVV Campus Jabalpur. The complete list of *Curcuma caesia* germplasm is presented with their locations in Table 1.
The qualitative morphological parameters such as type of stem leaf tip, leaf pubescence, leaf shape, stem colour, blade colour, rhizome colour, whereas quantitative traits like number of

tillers, plant height, number of leaf/stems, leaf length, leaf width, leaf thickness and stem diameter observed at vegetative growth phase. Rhizome colour was recorded after rhizome harvesting.

The mean value, standard deviation (SD), coefficient of variation (CV), and maximum and minimum values (summary statistics) for each character were determined using Microsoft excel. Pearson coefficient and correlations were calculated using SPSS statistical software (SPSS for Windows, SPSS Inc. Chicago, USA). Ward's hierarchical clustering (Ward 1963) was used to assess diversity in turmeric accessions. Hierarchical clustering was done using SPSS software.

Results and Discussion

A Black Turmeric plant (Fig. 2) had a flat green stem, many fibrous roots and aerial shoots (pseudostem) with acuminate leaf. Morphological characters of turmeric germplasm showed variations in the colour of the leaf and slight variation found on rhizome as demonstrated in Fig.3. Variations on the leaf of black turmeric are presented in Table 2. Most germplasm had a dark green leaf colour and a purplish red mid vein. Only MP/C/006 and MP/C/008 had the leaf's light purplish red mid-vain colour. All the black turmeric germplasm showed a white crown flower with a thin red stripe edge, lanceolate leaf with acuminate tip and base, and green leaf vein. The upper surface of the leaf was rough, and the lower leaf surface was smooth (Table 2).

Pearson correlation coefficient between morphological characters of the black turmeric germplasms is given in Table 3. Almost all the characteristics such as plant height, number of leaves, leaf width, leaf length, and leaf thickness significantly correlate with stem diameter. Plant height has a significant positive correlation with leaf length and leaf width. Leaf length positively correlates with leaf width and significantly between leaf width and thickness. The number of tillers did not show a significant correlation between plant height, number of leaves, leaf length, width, and thickness. Based on rhizome colour (Fig. 4), Jaccard Indexing formed two clusters; in cluster one, eight germplasm forming groups based on colour similarity were dark blue colour. Another cluster had only two germplasm (MP/C/006 and MP/C/008) mentioned in Fig. 5A.

Hierarchical clustering using Ward's method assembled accessions from Madhya Pradesh into three clusters based on morphological traits. Cluster I included five germplasm (MP/C/001, MP/C/003, MP/C/007, MP/C/008, and MP/C/009) having higher similarity based on morphological characteristics. In cluster II, only two germplasms MP/C/002 and MP/C/006 showed more similarity and Cluster III comprised three germplasms (MP/C/004, MP/C/005 and MP/C/010) based on numbers of tillers, plant height, leaf length and stem diameter (Fig. 5B; Table 4).

Different characters of several accessions could be due to various factors, including the origin of accessions, growth environment, and genetic factors. All the characterized germplasm were derived from an environmental condition with differences in agro-climatic conditions affecting plant morphological characters. Current information on specific morphological characteristics and use of plant material in today's society was based on rhizomes review by Pathan *et al.* (2013) [6]. Borah *et al.* (2013) [2] reviewed the ethnobotany of black turmeric and its importance. They concluded that morphological differences were due to the environmental and genetic interaction primarily for quantitative characters but were smaller on qualitative ones.

Table 1: List of *Curcuma cassia* germplasm collected from a different area of Madhya Pradesh, India

S. No.	Accession No.	Date of Collection	Location	Longitude	Latitude
1.	MP/C/001	23.02.2021	Polipathar	23.12308	79.93222
2.	MP/C/002	02.03.2021	Forest of Sagar	23.81507	78.76073
3.	MP/C/003	10.02.2021	Sidhi	24.10219	81.7381
4.	MP/C/004	20.06.2021	Mandla	22.30015	80.20965
5.	MP/C/005	20.06.2021	Forest of Mandla	22.30015	80.20965
6.	MP/C/006	20.06.2021	Katni	23.86304	80.29958
7.	MP/C/007	20.06.2021	Amarkantak	22.60701	81.70033
8.	MP/C/008	20.06.2021	Jabalpur	23.12308	79.93222
9.	MP/C/009	20.06.2021	Sahdol	23.29993	81.40897
10.	MP/C/010	25.06.2021	JNKVV, Jabalpur	23.21390	79.9581

Table 2: Morphological characteristics of *Curcuma cassia* germplasm collected from a different area of Madhya Pradesh

Accession	Stem type	Leaf Tip	Leaf base	Leaf shape	Stem colour	Blade Colour	Leaf pubescence		Rhizome Colour
							Upper	Lower	
MP/C/001	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/002	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/003	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/004	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/005	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/006	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with slight purplish red color along the main vein	Rough	Smooth	Light Blue
MP/C/007	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue

MP/C/008	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with slight purplish red color along the main vein	Rough	Smooth	Light Blue
MP/C/009	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue
MP/C/010	Flat	Acuminate	Acuminate	Lanceolate	Green	Green with Dark purplish red color along the main vein	Rough	Smooth	Dark Blue

Table 3: Pearson correlation coefficients relation based on growth characteristics of different germplasm of black turmeric

Pearson correlation coefficients Correlations							
	NT	**PH**	**NL**	**LL**	**LW**	**LFT**	**SD**
NT	1	0.350	0.098	0.220	0.253	0.123	0.335
PH		1	0.558	0.890**	0.873**	0.583	0.923**
NL			1	0.560	0.332	0.382	0.735*
LL				1	0.868**	0.775*	0.895**
LW					1	0.813**	0.829**
LFT						1	0.746*
SD							1
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed). Note – NT- Number of Tillers, PH- Plant Height, LL- Leaf Length, LW- Leaf width, LFT- Leaf Thickness, SD- Stem Diameter							

Table 4: Growth characters of *Curcuma caesia* germplasm

Accession	Number of tillers	Plant height (cm)	Number of leaf/plants	Leaf length (cm)	Leaves width (cm)	Leaf thickness (mm)	Stem diameter (mm)
MP/C/001	4.5	78.35	9.22	39.4 5	13.56	0.3	15.7
MP/C/002	3.5	65.55	9.5	34.37	12.24	0.3	14.2
MP/C/003	4.05	66.13	9.55	40.83	12.39	0.3	13.71
MP/C/004	4	48.83	6.94	26.44	10.79	0.29	9.66
MP/C/005	4	52.18	8.06	23.65	8.84	0.27	9.12
MP/C/006	3.5	56.71	9.55	30.91	11.35	0.3	12.44
MP/C/007	5.5	67.33	9.33	35.53	12.36	0.3	14.53
MP/C/008	4.5	67.92	8.67	36.01	13.58	0.3	13.31
MP/C/009	4	75.87	8.5	38.89	14.45	0.3	14.3
MP/C/010	4	57.37	6.94	31.59	11.93	0.3	11.09
Mean	4.155	63.624	8.626	33.13556	12.149	0.296	12.806
SD	0.578528	9.693885	1.01889	5.590011	1.596068	0.009661	2.189785
CV	14%	15%	12%	17%	13%	3%	17%

Fig 1: Different locations of collected germplasms in Madhya Pradesh

Fig 2: Black Turmeric Plants (*Curcuma caesia*)

Fig 3: Morphological characters based on shapes and colour variation on leaf blade of Black Turmeric

Fig 4: Colour variation in rhizome of *Curcuma caesia*

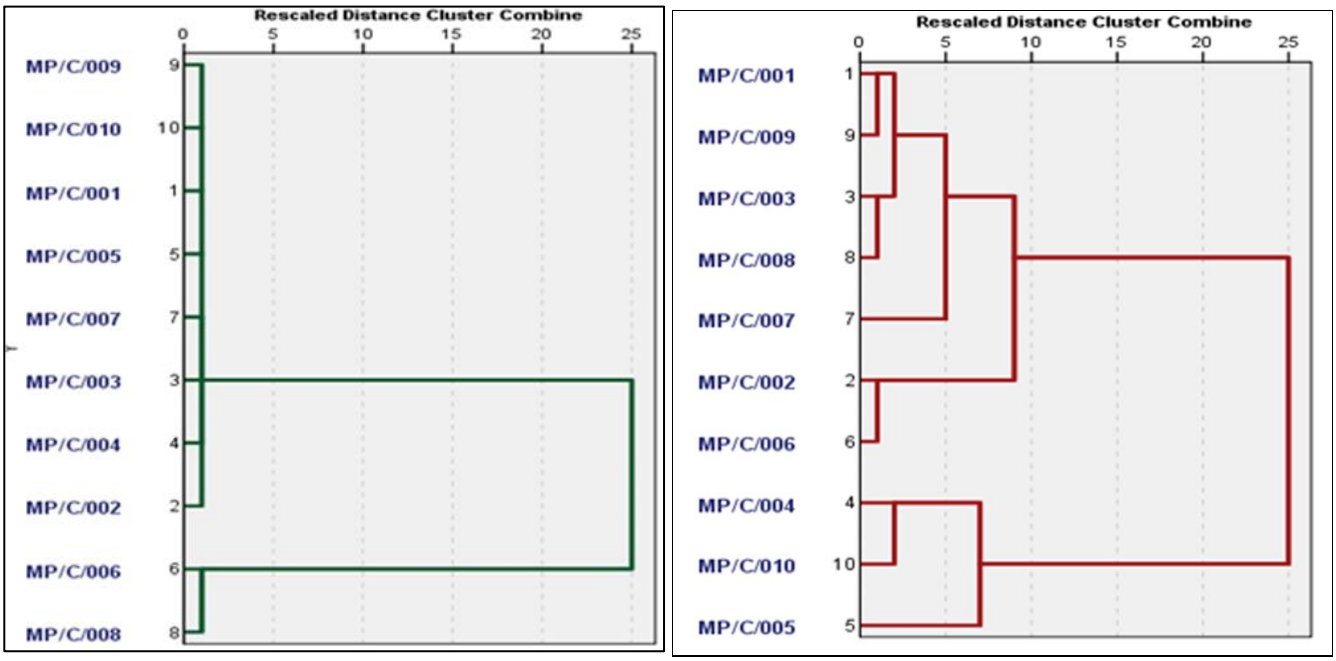

Fig 5: (A) Based on Jaccard indexing rhizome colour clustering in different germplasm of black turmeric. (B) Grouping of the black turmeric germplasm according to growth characters based on Standardized Squared Euclidean Distance applied to Wards Hierarchical Analysis.

The present study concluded that morpho-agronomic characteristics of germplasm of *Curcuma caesia* varied. Most accessions have a dark green colour on the blade, with purplish-red colour along the central vein. However, cluster analysis has proved to be an effective method in grouping turmeric accessions that may facilitate effective utilization of the accession in crop improvement programmes through selection, as conventional breeding is difficult in this crop. Moreover, correlation analysis of morphological traits indicated that tall plants having longer and broader leaves with a higher number of suckers/plants will be an ideal plant type for higher rhizome yield. Madhya Pradesh is an influential traditional belt for wide genetic diversity, thus requiring considerable attention in this respect.

References

1. Baghel SS, Baghel RS, Sharma K, Sikarwar I. Pharmacological activities of *Curcuma caesia*. International Journal of Green Pharmacy. 2013;7:1-5.
2. Borah A, Paw M, Gogoi R, Loying R, Sarma N, *et al*. Chemical composition, antioxidant, anti-inflammatory, antimicrobial and *in vitro* cytotoxic efficacy of essential oil of *Curcuma caesia* Roxb. Leaves: An endangered medicinal plant of North East India. Industrial Crops and Products. 2019;129:448-454.
3. Karmakar I, Saha P, Sarkar N, Bhattacharya S, Haldar PK. Neuro pharmacological assessment of *Curcuma caesia* rhizome in experimental animal models. Oriental Pharmacy and Experimental Medicine. 2011;11:251-255.
4. Liu Y, Roy SS, Nebie RHC, Zhang Y, Nair MG. Functional food quality of *Curcuma caesia*, *Curcuma zedoaria* and *Curcuma aeruginosa* endemic to North eastern India. Plant Foods for Human Nutrition. 2013;68:72-77.
5. Paw M, Gogoi R, Sarma N, Pandey SK, Borah A, Begum T, Lal M. Study of antioxidant, anti-inflammatory, genotoxicity, and antimicrobial activities and analysis of different constituents found in rhizome essential oil of *Curcuma caesia* Roxb., collected from North East India. Current Pharmaceutical Biotechnology. 2020;21(5):403-413.
6. Pathan AR, Vadnere GP, Sabu M. *Curcuma caesia* Almost Untouched Drug: An Updated Ethnopharmacological Review. Inventi Rapid: Planta Activa. 2013;(4):1-4.
7. Sahu B, Kenwat R, Chandrakar S. Medicinal value of *Curcuma cassia* Roxb: an overview. UK Journal of Pharmaceutical and Bioscience. 2016;4:69-74.
8. Sahu VK, Tiwari S, Tripathi MK, Gupta N, Tomar RS, Yasin M. Morpho-physiological and biochemical traits analysis for Fusarium wilt disease using gene-based markers in desi and Kabuli genotypes of chickpea (*Cicer arietinum* L.). Indian J Genet. 2020;80(2):163-172.
9. Wahyuni S, Bermawie N, Kristina NN. Morphological characteristics, yield potential, and major rhizome constituent of nine accession numbers of wild ginger. Industrial Crops and Products. 2013;19(3):99-107.