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Study of host specific pathogenic basidiomycetes fungi from Dadra and Nagar Haveli (DNH) District

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Abstract
This study presents way to the guidance and necessary procedures requirements for the collection, study and analysis of host specific basidiomycetes species across the areas in Dadra and Nagar Haveli District. The study aims to detect the presence and analysis of characteristics of spores of host specific basidiomycetes species distributed in the areas of District Dadra and Nagar Haveli. Field surveys were made during June 2024 to Dec 2025 across the areas of DNH District. Spores of 24 species of host specific pathogenic basidiomycetes belonging to 18 genera and families were studied with characteristics *viz*. size, shape, colour, appearance etc. Host relationship and disease caused by pathogenic basidiomycetes were studied. Most of the rust fungi were collected from herbaceous and shrubby hosts, while few were found to be pathogens of tree species also. The research study further recommends further exploration of host specific basidiomycetes species from the areas of Union Territory of Dadra and Nagar Haveli.

Keywords: Basidiomycetes, basidiospores, Dadra and Nagar Haveli (DNH), fungi, pathogen, rust, smut

Introduction
Basidiomycetes are characterized by the formation of basidia and basidiospores. Many members are obligate or facultative parasites of crop plants. Crop-specific basidiomycetes mainly belong to rust fungi (Pucciniales) and smut fungi (Ustilaginales) [9, 15]. Basidiospores comprise variety of sizes, shapes and colours and may be either thick or thin walled and smooth or ornamented. Many basidiomycetes fungi cause destruction of a wide varity crops [3, 12]. Major crop specific basidiomycetes fungi which cause rust are *Puccinia graminis, Puccinia angustata, Puccinia coronata* and *Puccinia asparagi* etc. Rust fungi are obligate parasites with high host specificity. Major crop specific basidiomycetes fungi which cause smut are *Ustilago maydis, Ustilago avenae, Ustilago hordae, Tilletia indica, Urocystis anemones, Schizonella melanogramma* and *Ustilaginoidea virens etc*. Most basidiomycetes show narrow host range. The variability in climatic conditions and biological diversity is important in the growth and development of various plant pathogenic fungi. The broad diversity of rust fungi has also been observed in the country due to the availability of favourable agro-climatic conditions required for the initiation of infection and disease development [1]. It has been reported earlier that rust diseases are abundant in hilly region where high relative humidity and thick vegetal cover provides ideal and congenial condition for the growth and development of these diseases [10]. The disease involves several spore stages, which enable their determination and spread under favourable environmental conditions [3, 9]. Most basidiomycetes fungi show strict host specificity due to co-evolution with crop plants. They cause serious yield losses, reduce grain quality, and affect crop market value. In view these facts, the present study was undertaken to explore and assess the diversity and distribution of pathogenic basidiomycetes fungi along with their respective host plants across the areas from of Dadra and Nagar Haveli District.

Materials and methods
Study Area
The Dadra and Nagar Haveli District comprises area of 491 square kilometers. It is situated close to the western coast of India between 20°0′ and 20°25′ N latitude and between 72°50′ and 73°15′ E longitude. About 43 per cent of the land is under forest cover. However, the reserved forest territory constitutes about 40 per cent of the total geographical area. The protected forests constitute 2.45 per cent of the total land area. It has roughly about 114 square kilometres (28,000 acres) of moderately dense forest and 94 square kilometres (23,000 acres) open forest. In summer, it has hot and humid climate with temperature more than 30^0 C and in winter, temperature ranging from 14^0 C to 30^0 C with tropical climate. DNH has annual rainfall of 200–250 cm.

Field Survey
The crop fields and forest areas of Dadra and Nagar Haveli *viz*. Ambabari, Amboli, Amli, Bedpa, Bonta, Chinchpada, Dhapsa, Dudhni, Gunsa, Galonda, Karachgam, Kauncha, Khanvel, Khedpa, Kilvani, Kothar, Luhari, Morkhal, Mota Randha, Nana Randha, Rakholi, Shelti, Surangi, Umarkui, Velugam etc. were surveyed during growth phase of crops and monsoon during June 2024 to Dec 2025.

Sample Collection
Samples were collected from forest and crop fields in Dadra and Nagar Haveli District. Infected plant parts were collected with proper care and transferred in to sterile wide mouth plastic bottles. Tools like forceps, knife as well as steel spatula was used for the collection of samples.

Microscopic Examination
Collected samples were taken into laboratory for microscopic examination of rust and smuts. Microscopic slides for both rust and smut fungi in infected crop tissue were prepared using stain Lactophenol Cotton Blue (LPCB).

Symptoms and characters of rust and smut caused by pycniospores, aeciospores, urediniospores, teliospores and basidiospores were observed under digital microscope.

Preservation

Samples of basidiomycetes species with infected parts of plants were preserved in F.A.A. Solution (Formalin-Acetic Acid-Alcohol). The formulation of F.A.A includes 50 per cent alcohol, 5 per cent glacial acetic acid, 10 per cent formaldehyde and 35 per cent distilled water. Some crop specific basidiomycetes specimens were preserved as permanent microscopic slides.

Results and Discussion

The pathogenic basidimycetes were identified based on their morphological characteristics by referring to standard mycological identification & relevant literature. The study aims to detect the presence and analysis of characteristics of spores of host specific basidiomycetes species distributed in the areas of District Dadra and Nagar Haveli. The number of different basidiospores types identified from basidiomycetes in host specific plants varied; sometimes there was only a differentiation between basidiospores and spores from smuts in other cases more types of basidiospores are described. Among the 24 host specific basidiomycetes studied, 06 species belong to family Pucciniaceae causing rust and 04 species belongs to family Ustilaginaceae causing smut in host plants. Among the host plants of examined pathogenic fungi, 18 were herbaceous plants, 03 shrubby plants and 03 were trees.

1. *Aecidium majanthae* Schumach., 1803

Aeciospores: Globuse or angular, around 20-35 µm in diameter, yellowish, powdery, verrucose wall, dispersal wind borne.
Host plant: *Maianthemum bifolium*
Distribution in DNH: Bonta, Nana Randha, Dudhani, Vaghchauda, Velugam, Surangi etc.

2. *Cerotelium fici* Arthur, Bull. Torrey Bot. Club 44: 509 (1917)

Uredospores: Ellipsoid, obovoid, to polygonal or rounded, size typically ranges from 17–38 μm in length by 11–27 μm in width, with an average size of approximately 23×19 μm, surface covered with covered with small, spiky ornamentations, typically yellowish to faintly orange or pale reddish-brown.
Host plant: *Ficus religiosa*, *Ficus benghalensis*, *Morus alba (*Mulberry*)*
Distribution in DNH: Bonta, Dudhani, Vaghchauda, Kilavani, Luhari, Morkhal etc.

3. *Coleosporium solidaginis* Schwein, Thüm., Bull. Torrey Bot. Club 6 (39): 216 (1878)

Uredospores: Sub-globose, globose, to ellipsoid or obovoid, size typically ranges 20–38 μm in length by 14–26 μm in width, bright yellow-orange to golden-yellow, walls are varrucose.
Host plant: *Solidago* (Goldenrod), *Aster sps.*
Distribution in DNH: Naroli, Umarkui, Velugam, Rakholi, Shelti, Mandoni, Bonta, Surangi etc.

4. *Cronartium ribicola* J.C. Fisch., Fungi Europaei exsiccati Cent. 16: no. 1595 (1872)

Uredospores: Globose to ellipsoid**,** size ranges from 1–2 μm in diameter, thick-walled and robust, wart-like surface projections, tiny, yellow-orange, powdery, circular pustules on the underside of leaves of *Ribes*.
Host plant: *Ribes nigrum* (Karonda),
Distribution in DNH: Amboli, Nana Randha, Dudhani, Vaghchauda, Chinchpada, Karachgam, Kauncha etc.

5. *Entyloma austral* Speg., Anales Soc. Ci. Argent. 10 (1): 5 (1880)

Teliospores: Oval or angular, 08–12 µm in size, hyaline to yellowish, smooth-walled, typically composed of two distinct layers.
Host plant: *Physalis peruviana* (Goldenberry), *Petunia*
Distribution in DNH: Khedpa, Khanvel, Gunsa, Galonda, Dudhani, Chinsda, Mota Randha, Parzai etc.

6. *Exobasidium vaccinii* Freiburg 4 (4): 397 (1867)

Basidiospores: 10–12 µm long, musiform or banana-shaped, 4 to 7 basidiospores are developed per basidium.
Host plant: *Fragaria* (Strawberry)
Distribution in DNH: Dudhani, Shelti, Tighra, Umarkui, Medha, Surangi, Khanvel, Vasona, Kudacha etc.

7. *Gymnoconia nitens* (Schwein.) F. Kern & Thurst 16 (1929)

Aeciospores: 16-22 µm in diameter, yellow to orange, powdery in mass, waxy, blister like appearance, Globoid or obovoid,.
Host plant: *Rubus* species
Distribution in DNH: Mota Randha, Saily, Dudhani, Bonta, Velugam, Karachgam, Khanvel etc.

8. *Gymnosporangium globosum* Farl., Bot. Gaz. (London) 11: 236 (1886)

Teliospores: Generally 30-35 µm in length and 16-23 µm in width, gelatinous, orange-brown, yellow to light brown.
Host plant: *Juniperus virginiana (Red cedar)*
Distribution in DNH: Surangi, Bonta, Dhapsa, Dudhani, Nana Randha, Umarkui, Kauncha, Galonda etc.

9. *Hyalopsora polypodii* Ber. Deutsch. Bot. Ges. 19: 582 (1901)

Uredospores: 16–22 µm, oblong or obovate-elliptic, yellowish orange, thin, hyaline wall.
Host plant: *Polypodium (Fern)*
Distribution in DNH: Kilavani, Umarkui, Athal, Gunsa, Khutali, Bonta, Randha, Morkhal etc.

10. *Irpex lacteus* Fr., Elenchus Fungorum 1: 145 (1828)

Basidiospores: 3–7 µm, Hyaline, smooth, elliptical to sub cylindric, They are produced on basidia that are part of an irpicoid (toothed) hymenophore.
Host plant: *Oak tree*
Distribution in DNH: Umarkui, Bonta, Nana Randha, Dudhani, Vaghchauda, Silli, Velugam etc

11. *Melampsora lini* Rheinl. Westphalens: 10 (1865)

Basidiospores: 14–16 µm, ellipsoid, ovoid or obovoid, orange-yellow colour.
Host plant: *Linum* species (Linseed)
Distribution in DNH: Falandi, Khanvel, Khadoli, Dudhani, Samarvarni, Talavli etc.

12. *Phragmidium sps* Freunde Berlin 7: 30 (1816)
Teliospores: 40–60 µm length, cylindrical, multicellular, multi-celled (typically 1–8 cells, often 5–7), pigmented (chestnut-brown), and thick-walled, commonly measuring 57–147 x 22–43 µm.
Host plant: *Rose*
Distribution in DNH: Galonda, Khanvel, Dudhani, Chinchpada, Kherarbari, Bonta, Dhapsa etc

13. *Puccinia angustata* G. Winter, Hedwigia 19: 38 (1880)
Urediospores: ellipsoid, obovoid (egg-shaped), or oblong**,** 18–24 µm, rusty red, spore wall (epispore) is echinulate (covered with small spines or spikes).
Host plant: *Scirpus (Sedge)*
Distribution in DNH: Bonta, Nana Randha, Dudhani, Khanvel, Surangi, Khanvel etc.

14. *Puccinia asparagi* Flore française, Ed. 3 2: 595 (1805*)*
Urediospores: 14–20 µm, small, usually oval, blister like, reddish brown, When mature, they are released in powdery masses from pustules (uredia) on the stems and foliage.
Host plant: *Asparagus*
Distribution in DNH: Bildhari, Chikhali, Khanvel, Bonta, Umarkui, Velugam, Nana Randha etc

15. *Puccinia coronate* var. lolii Beeynck (1853)
Urediospores: 16–22 µm, globuse, spiny, orange yellow
Host Plant: *Avena sativa* (Oats)
Distribution in DNH: Dhapsa, Amboli, Karchond, Chinchpada, Surangi, Tighra etc.

16. *Puccinia graminis* Pers., Neues Mag. Bot. 1: 119 (1794)
Teliospores: 18–22 µm, black, spindle shape, thick-walled, and appear in high concentrations (sori) on the infected wheat kernels or leaves
Host plant: *Triticum (Wheat)*
Distribution in DNH: Galonda, Mota Randha, Samarvarni, Khanvel, Dudhani, Kherdi etc.

17. *Rhizoctonia solani* Ursachen und Verbreitung: 224 (1858)
Sclerotia: Brown, Irregular, hemispherical or oval, compact, hardened resting structures (aggregates of monilioid cells) that serve as long-term survival units
Host plant: *Rice*
Distribution in DNH: Dudhani, Mota Randha, Nana Randha, Dolara, Kilavani, Kauncha, Demani etc.

18. *Schizonella melanogramma* Magnus, Hedwigia 14 (2): 19 (1875)
Teliospores: 5–15 µm, yellowish, angular and in clusters
Host plant: *Carex* (Motha grass)
Distribution in DNH: Khanvel, Kudacha, Bildhari, Dapada, Athola, Galonda, Besda, Khadoli etc

19. *Urocystis anemones* Buenos Aires Ser. 3, 1: 59 (1902)
Teliospores: 14–28 µm, arranged in balls, yellow-brown, spores are aggregated into spore balls (sori).
Host plant: *Anemone*
Distribution in DNH: Chikhali, Goratpada, Bonta, Randha, Falandi, Dolara, Kanadi, Kilavani etc

20. *Uromyces trifolii* Ann. Mycol. 14 (3-4): 248 (1916)
Urediospores: 16–30 µm, globuse, yellow brown, powdery, appear as a powdery mass within pustules
Host plant: *Trifolium sps* (Clover)
Distribution in DNH: Khedpa, Mandoni, Tighra, Morkhal, Kauncha, Chinchpada etc

21. *Ustilago avenae* (Pers.) Rostr. Medlemmers Arbeider 1890 (2): 13 (1890)
Teliospores: 5–08 µm, spiny, black, thick wall, powdery, characterized by a finely echinulate (spiny) or sometimes smooth surface
Host plant: *Avena sativa* (Oat)
Distribution in DNH: Sindoni, Chinsda, Velugam, Dudhani, Bonta, Besda, Velugam etc.

22. *Ustilago cynodontis* (Pass.) Henn., Bull. Herb. Boissier 1: 114 (1893)
Teliospores: 6–08 µm, spherical, brownish, smooth thick wall, which form in the inflorescences of Bermuda grass (*Cynodon dactylon*), are typically thick-walled and serve as the dormant, spreading phase of the fungus
Host plant: *Cynodon dactylon (Bermuda grass)*
Distribution in DNH: Kauncha, Morkhal, Kilavani, Rakholi, Kudacha, Dudhani, Surangi etc.

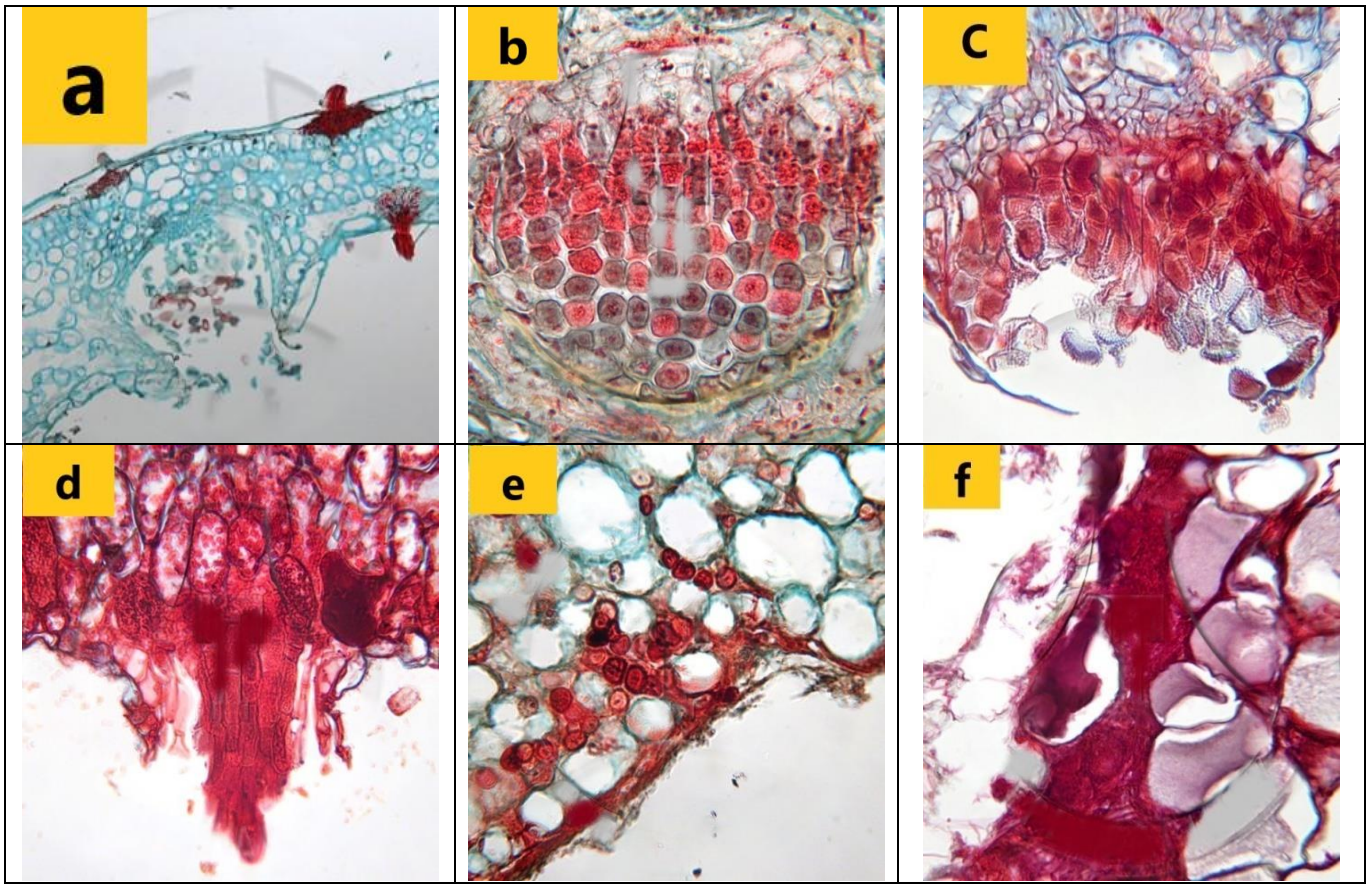
23. *Ustilago horde* var. tecta C.N. Jensen
Teliospores: 6–08 µm, spherical, brownish, smooth thick wall, often forming a black, sooty, and powdery mass that replaces the host's grain
Host plant: *Hordeum vulgare (Barley)*
Distribution in DNH: Dudhani, Umarkui, Kilavani, Surangi, Samarvarni, Bonta etc

24. *Ustilago maydis* (DC.) Corda cognitorum 5: 3 (1842)
Teliospores: 8–12 µm, spherical, brownish, covered with tiny spines (echinulate).
Host plant: *Zea mays*
Distribution in DNH: Talavli, Medha, Velugam, Dudhani, Khanvel, Galonda, Kauncha etc.

Table 1: List of plant specific basidiomycetes species from the Dadra and Nagar Haveli District (DNH)

S. No.	Basidiomycetes species	Host plants	Types of spores	Discription of spores	Disease caused
1	*Aecidium majanthae*	*Majanthemum (Lilly)*	Aeciospores	Light Yellowish, globose to ellipsoid and powdery	Rust on leaves
2	*Cerotelium fici*	*Morus alba* (Mulberry)	Uredospore	Tiny, dark, circular pustules on leaf undersides	Black leaf rust
3	*Coleosporium solidaginis*	*Solidago* (Goldenrod)	Uredospores	Uredospores are yellow-orange powdery pustules	Leaf rust
4	*Cronartium ribicola*	*Ribes nigrum* (Karonda)	Uredospores	Yellow-orange, powdery pustules on the underside of the leaves	Blister rust
5	*Entyloma australe*	*Physalis peruviana*	Teliospores	08–12 µm, globose to subglobose, hyaline	Smut

		(Goldenberry), *Petunia*		to yellowish, smooth-walled	
6	*Exobasidium vaccinii*	*Fragaria (Strawberry)*	Basidiospores	10–12 µm, musiform or banana-shaped	Leaf and flower galls
7	*Gymnoconia nitens*	*Rubus* species	Aeciospores	Waxy, powdery, yellow-orange	Orange rust
8	*Gymnosporangium globosum*	*Juniperus virginiana (Red cedar)*	Teliospores	Gelatinous, orange-brown	Cedar-hawthorn rust
9	*Hyalopsora polypodii*	*Polypodium (Fern)*	Urediospores	16–22 µm, oblong or obovate, hyaline	Rust
10	*Irpex lacteus*	*Oak tree*	Basidiospores	3–7 µm, Hyaline, smooth, elliptical to subcylindric	White rot
11	*Melampsora lini*	*Linum* species (Linseed)	Urediospores	14–16 µm, ellipsoid, ovoid or obovoid, orange-yellow	Flax rust
12	*Phragmidium sps*	*Rose*	Teliospores	40–60 µm length, cylindrical, multicellular,	Rose rust
13	*Puccinia angustata*	*Scirpus (Sedge)*	Urediospores	18–24 µm, oval, elliptic, or pear-shaped, rusty red.	Rust in Sedges
14	*Puccinia asparagi*	*Asparagus*	Urediospores	14–20 µm, small, usually oval, blister like, reddish brown	Rust in Asparagus
15	*Puccinia coronata*	*Avena sativa* (Oats)	Urediospores	16–22 µm, globuse, spiny, orange yellow	Crown rust in Oats
16	*Puccinia graminis*	*Triticum (Wheat)*	Teliospores	18–22 µm, black, thick, spindle shape	Rust in wheat
17	*Rhizoctonia solani*	*Rice*	Sclerotia	Brown, Irregular, hemispherical, or oval	Sheath blight in Rice
18	*Schizonella melanogramma*	*Carex (*Motha grass*)*	Teliospores	5–15 µm, yellowish, angular and in clusters	Smut in Sedges
19	*Urocystis anemones*	*Anemone*	Teliospores	14–28 µm, arranged in balls, yellow-brown	Smut in sori
20	*Uromyces trifolii*	*Trifolium sps* (Clover)	Urediospores	16–30 µm, globuse, yellow brown, powdery	Clover rust
21	*Ustilago avenae*	*Avena sativa* (Oat)	Teliospores	5–08 µm, spiny, black, thick wall, powdery	Loose smut of Oat
22	*Ustilago cynodontis*	*Cynodon dactylon* (Bermuda grass)	Teliospores	6–08 µm, spherical, brownish, smooth thick wall	Smut in Cynodon
23	*Ustilago horde*	*Hordeum vulgare* (Barley)	Teliospores	6–10 µm, globuse, smooth, black	Covered smut in Barley
24	*Ustilago maydis*	*Zea mays*	Teliospores	8–12 µm, spherical, brownish	Corn smut



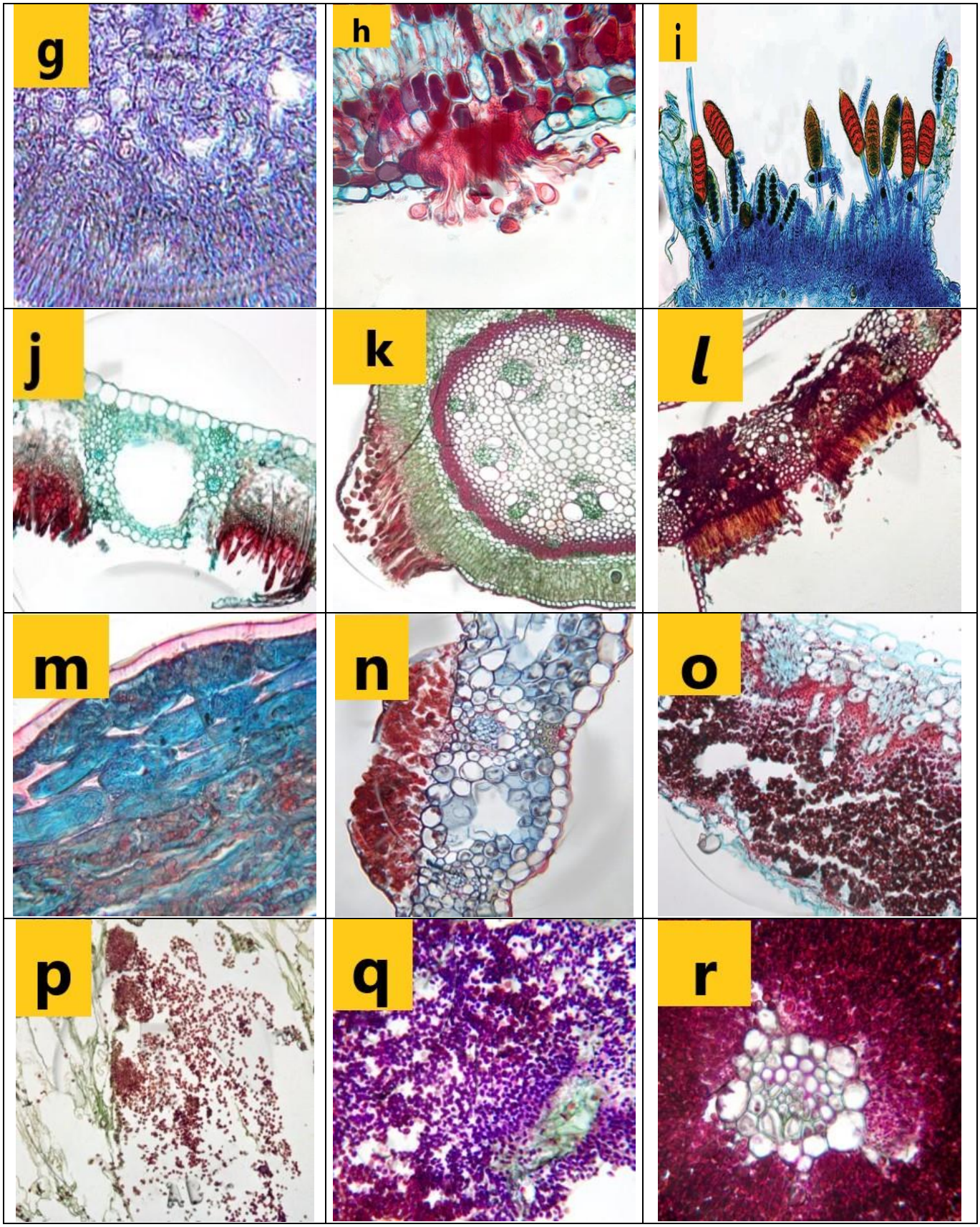


Fig 1: Some images of slides of spores of host specific basidiomycetes in the Dadra and Nagar Haveli District a. *Aecidium majanthae*, b. *Cerotelium fici*, c. *Coleosporium solidaginis*, d. *Cronartium ribicola*, e. *Entyloma australe*, f. *Exobasidium vaccinii*, g. *Irpex lacteus*, h. *Melampsora lini*, i. *Phragmidium sps*, j. *Puccinia angustata* k. *Puccinia asparagi*, l. *Puccinia graminis*, m. *Rhizoctonia solani*, n. *Schizonella melanogramma*, o. *Urocystis anemones* p. *Ustilago maydis* q. *Ustilago horde* r. *Ustilago maydis*

Conclusion

The study area has favorable climatic diversity, rich floral wealth and rich diversity of basidiomycetes fungi. Spores of 24 species of host specific pathogenic basidiomycetes belonging to 18 genera and 15 families were studied with characteristics *viz.* size, shape, colour, appearance etc.

(Table 1). Most of the rust fungi were collected from herbaceous and shrubby hosts, while few were found to be pathogens of tree species. Host relationship and disease caused by pathogenic basidiomycetes were studied across the areas from Dadra and Nagar Haveli District. The research study further recommends further exploration of host specific basidiomycetes species from the areas of Union Territory of Dadra and Nagar Haveli.

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Compliance with ethical standards
The article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of interest
We the authors do not have any conflict of interest to declare herewith.

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