



Morphological Variability of the *Curvularia lunata* Associated with Grain Discoloration of Rice

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Rice is an important staple crop and India is the largest grower in the world. Rice suffers from many diseases caused by fungi of which grain discoloration disease is a complex disease due to infection by certain microorganisms on the glumes, kernels, or both. *Curvularia lunata* is a one of major fungal plant pathogen that infects rice and causes grain discoloration. On the basis of cultural and morphological identification, 60 isolates of *Curvularia lunata* were collected from different locations of Karnataka. These isolates were grown on PDA media and were characterized for colony morphology. The *Curvularia lunata* isolates, maximum size of conidia was observed in CI-22 (20.30 μm long \times 10.90 μm wide) and maximum dry mycelium weight was observed in CI-15 (482.22 mg), while poor sporulations (<1-10 conidia per microscope field) was noticed in CI-17, 19, 28, 30, 45 and CI-50.

Keywords: *Curvularia lunata*; variability; cultural; morphological; grain discoloration.

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1. INTRODUCTION

Rice is one of the most important cereal crops of the country. Rice intensification deeply applied has increased chemical fertilizer application and developed more rice seasons yearly. This is one of the causes to increase damage by pests and diseases. Rice yield loss due to pests and diseases has been noticed more and more seriously. Grain discoloration is considered as one of popular problems in Karnataka.

Grain discoloration of paddy is a complex disease due to infection by certain microorganisms on the glumes, kernels, or both. The fungi that were reported to be associated with discoloration of grains are *Curvularia lunata* [highest (35.30%) in Tungabhadra Project (TBP) and Upper Krishna Project (UKP) areas of North Eastern Karnataka], *Alternaria alternata*, *Fusarium moniliforme*, *Bipolaris oryzae*, *Alternaria padwickii*, *Pyricularia oryzae*, *Fusarium graminearum*, *Nigrospora oryzae*, *Epicoccum nigrum*, *Phoma sorghina*, *Dichotomophthoropsis nymphacearum* and *Heterosporium echinunulatum* etc. [1].

Grain discoloration results in seedling mortality and reduction in germination and seedling vigour [2], causing significant yield loss. Thus, the pathogens causing grain discoloration have direct influence on both quantity and quality of seeds.

In nature, plant pathogens exist as different strains that exhibit variation in their morphological and cultural characters, pathogenicity and virulence. To understand the present plant disease situations and to predict the possible future development it is essential to learn as much as possible about the variability in fungi that are pathogenic to plants. Morphological and pathogenic variations are known in many fungal pathogens. Keeping in view, the importance of the crop and severity of the disease, present investigation was taken up to study the variability in cultural and morphological characters of *Curvularia lunata* isolates.

2. MATERIALS METHODS

The grain discoloration infected panicle/seed samples were collected from 16 districts of Karnataka during survey and pure hyphal tip cultures of 60 isolates were maintained on PDA and later morphological and cultural studies were carried out in laboratory.

The growth characters of predominant pathogens were studied on potato dextrose agar. The media were sterilized at 1.1 kg/cm² pressure for 15 min. To carryout the study, 20 ml of each of the medium was poured in 90 mm petriplates. Such petriplates were inoculated with 5mm disc cut from periphery of actively growing culture and incubated at 27±1°C. Each treatment was replicated thrice. Observations were taken when the fungus covered complete petriplate in any one of the media. The colony diameter was recorded. The fungus colony colour, margin and sporulation were also recorded. The data on radial growth was analyzed statistically. The colonies were characterised for phenotype and growth pattern and different morphotypes, shape (irregular and regular); growing pattern (circular and feathery); texture (velvety and cottony) were observed *in vitro*. Similarly, colour was differentiated into black and greyish black.

The composition and preparations of liquid media used, were the same as that of solid media except that the agar-agar was not added. The mycelial mat was harvested, dried and weighed and results were analyzed statistically.

3. RESULTS AND DISCUSSION

3.1 Morphological Variability

Morphological characters such as colony character, colony diameter, sporulation, spore germination, size of conidia, mycelium width and dry mycelium weight of sixty monoconidial hyphal tip isolates of *C. lunata* were studied. All the sixty isolates showed considerable variability with respect to colony characters, colony diameter, sporulation, size of conidia, mycelium width and dry mycelium weight (Fig. 1a &1b).

3.2 Size of Conidia and Dry Mycelium Weight

Maximum size of conidia was observed in CI-22 (20.30 µm long ×10.90 µm wide) followed by CI-25 (19.80 µm long × 9.10 µm wide). Minimum size of conidia was found in CI-54 (12.60 µm long × 7.20 µm wide). Although some of the isolates produced conidia of larger size but their width was very small and some conidia were length wise smaller but were wider comparatively thus indicating variability among the isolates with respect to conidial size. Maximum dry mycelium weight was observed in CI-15 (482.22 mg) followed by CI-52 (488.42 mg) and CI-59 (466.23

mg). Minimum dry mycelium weight was observed in CI-35 (180.96 mg).

3.3 Colony Colour

Colony colour varied from isolate to isolate i.e., light grey to black. CI-24, 26, 46 were showed black colour colonies, while CI-2, 4, 20, 36, 38, 40, 51 and 53 showed dark. Colony margin colour varied from isolate to isolate i.e., light grey to black. CI-9, 10, 12 were showing light grey colour colony margins and CI- 3, 4, 5, 49, 50, 52, 56 were showed grey colour colony margins while remaining were showed light brown, brown and black colour margins (Table 1).

3.4 Topography and Type of Margin

Topography varied from isolate to isolate i.e., fluffy, smooth to flat. Majority were showed

smooth growth viz., CI-10, 11, 16, 17, 19, 21, 23, 27, 28, 29, 31, 34, 35, 37, 38, 42, 46, 48, 50, 54, 55 and 56, while remaining were showed fluffy raised, raised and flat growth with regular and irregular margins (Table 1).

3.5 Colony Character

Growth of isolates viz., CI- 1, 2, 3, 4, 5, 6, 10, 12, 17, 20, 21, 22, 23, 24, 25, 26, 27, 32, 34, 35, 36, 38, 39, 40, 41, 42, 45, 46, 48, 49, 51, 52, 53, 54, 56, 57, 58, 59, 60 were excellent, fast growing and isolates CI-19,47,50 produced good growth. Excellent sporulation was (> 50 conidia per microscope field) observed by isolates CI-1, 2, 6, 15, 16, 20, 21, 25, 34, 35, 53, 54, 56, 57 and CI-58, while poor sporulation (<1-10 conidia per microscope field) was noticed in CI-17, 19, 28, 30, 45 and CI-50 (Table 1).

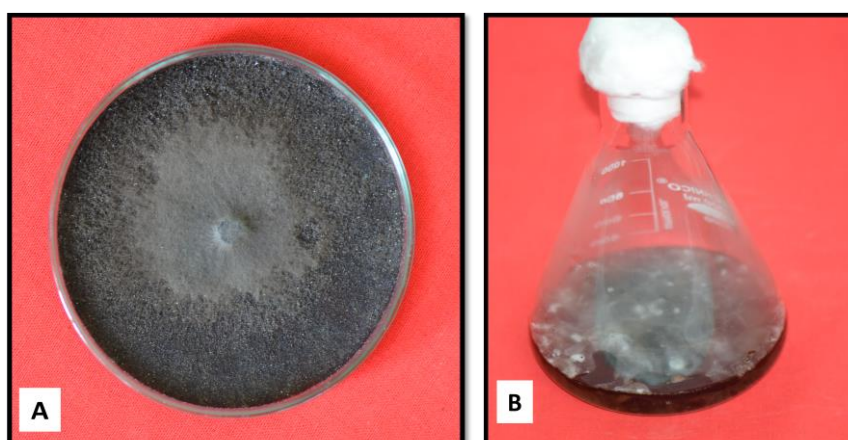


Fig 1a. Pure culture of predominant pathogen *Curvularia lunata* on A) PDA B) PDB

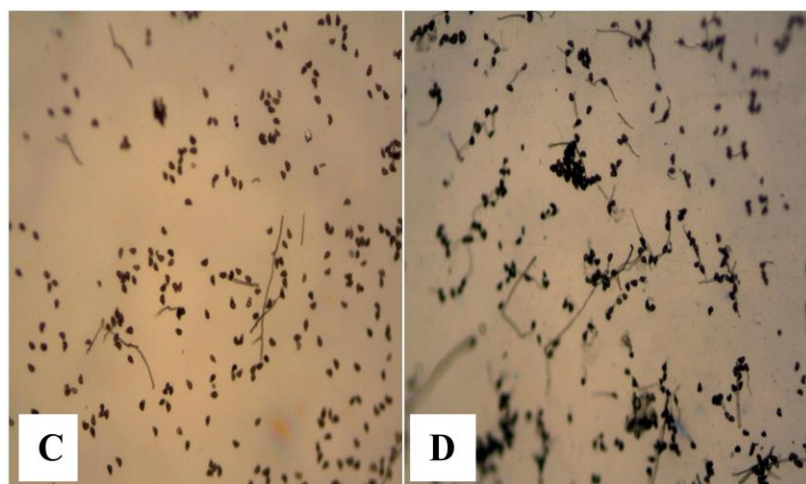


Fig 1b. Microphotograph of *Curvularia lunata* (10X magnification) C) conidia D) conidia germinated

Table 1. Morphological and cultural characteristics of *Curvularia lunata* isolates of paddy collected from different regions of Karnataka

Sl. No.	Location	Isolates	Colony Colour	Colony Growth	Type of margin	Margin colour	Growth in mm	Sporulation	Size of conidia (μm) (Length X Breadth)	Dry mycelial weight (mg)
1	Yadgir	CI-1	Dark gray to black	Flat	Irregular	Black	90	++++	14.40X9.50	394.44
2	Shahapur	CI-2	Dark gray	Fluffy raised	Regular	Black	90	++++	17.00X9.80	382.08
3	Shorapur	CI-3	Medium brown	Raised	Regular	Gray	80	+++	17.40x9.40	340.40
4	Shorapur	CI-4	Dark gray	Fluffy raised	Regular	Gray	90	+++	15.60X11.50	348.55
5	Raichur	CI-5	Medium gray	Fluffy raised	Regular	Gray	80	+++	18.40X10.20	320.74
6	Raichur	CI-6	Dark gray to black	Flat	Regular	Black	90	++++	13.00X7.40	331.05
7	Manvi	CI-7	Medium brown	Flat	Irregular	Black	70	++	18.00X10.20	340.56
8	Sindhnur	CI-8	Light Brown	Flat	Regular	Light brown	70	++	15.30X10.10	299.30
9	Devadurga	CI-9	Light gray	Fluffy	Regular	Light gray	60	++	14.70X8.80	240.57
10	Bellary	CI-10	Light gray	Smooth	Regular	Light gray	80	++	16.00X9.90	366.20
11	Hosapet	CI-11	Dark Brown	Smooth	Regular	Light brown	70	++	16.50X7.40	289.40
12	Siraguppa	CI-12	Light gray	Fluffy	Irregular	Light gray	80	+++	15.40X10.80	421.44
13.	Siraguppa	CI-13	Medium grey	Raised	Regular	Light brown	70	+++	17.00X10.40	432.66
14	Koppal	CI-14	Dark gray to black	Raised	Irregular	Black	60	+++	15.80X11.70	450.15
15	Gangavathi	CI-15	Dark gray to black	Flat	Irregular	Black	70	++++	14.50X7.80	466.22
16	Gangavathi	CI-16	Medium brown	Smooth	Irregular	Light brown	70	++++	15.10X9.80	451.39
17	Davangere	CI-17	Dark brown to black	Smooth	Regular	Black	90	+	18.30X10.20	327.46
18.	Harihar	CI-18	Dark gray to black	Raised	Irregular	Black	60	++	16.30X9.00	260.45
19	Harihar	CI-19	Dark Brown	Smooth	Irregular	Black	50	+	17.10X7.20	250.66

Sl. No.	Location	Isolates	Colony Colour	Colony Growth	Type of margin	Margin colour	Growth in mm	Sporulation	Size of conidia (μm) (Length X Breadth)	Dry mycelial weight (mg)
20	Shimoga	CI-20	Dark Gray	Fluffy raised	Regular	Black	90	++++	14.90X9.10	388.43
21	Shimoga	CI-21	Dark gray to black	Smooth	Regular	Brown	90	++++	16.50X8.90	376.40
22	Tirthahalli	CI-22	Dark Brown	Fluffy raised	Irregular	Brown	90	+++	20.30X10.90	210.33
23	Bhadravati	CI-23	Medium gray	Smooth	Regular	Black	90	+++	14.40X8.50	320.60
24	Hosanagar	CI-24	Black	Fluffy	Regular	Black	80	+++	15.20X7.10	352.44
25	Sirsi	CI-25	Dark brown	Fluffy	Regular	Black	90	++++	19.80X9.10	349.21
26	Sirsi	CI-26	Black	Fluffy	Regular	Black	90	+++	16.40X9.60	288.45
27	Yellapur	CI-27	Dark brown	Smooth	Regular	Brown	80	++	16.40X9.40	212.87
28	Mundgod	CI-28	Medium brown	Smooth	Irregular	Light brown	60	+	14.70X9.00	210.44
29	Hassan	CI-29	Medium brown	Smooth	Irregular	Light brown	70	++	15.10X6.30	278.50
30	Alur	CI-30	Medium brown	Raised	Irregular	Light brown	60	+	17.10X11.10	310.48
31	Alur	CI-31	Medium brown	Smooth	Irregular	Light brown	60	++	15.70X8.00	368.44
32	Sakleshpur	CI-32	Light brown	Fluffy raised	Regular	Brown	90	+++	15.10X10.20	466.50
33	Chikamagalur	CI-33	Dark gray to black	Fluffy	Irregular	Black	70	++	17.50X7.00	356.28
34	Koppa	CI-34	Dark gray to black	Smooth	Regular	Black	90	++++	15.70X8.00	278.36
35	Mudigere	CI-35	Dark gray to black	Smooth	Regular	Black	80	++++	15.40X7.70	180.96
36	Mudigere	CI-36	Dark gray	Fluffy raised	Regular	Brown	80	+++	18.20X8.50	248.69
37	Madikeri	CI-37	Dark brown	Smooth	Irregular	Brown	70	++	16.40X9.60	310.56
38	Virajpet	CI-38	Dark gray	Smooth	Regular	Black	90	+++	18.50X8.40	330.78
39	Virajpet	CI-39	Dark gray to black	Fluffy	Regular	Black	90	+++	14.00X6.40	410.95
40	Mangalore	CI-40	Dark gray	Fluffy raised	Regular	Brown	90	+++	17.00X6.70	421.55
41	Mangalore	CI-41	Dark gray to black	Flat	Regular	Black	90	+++	18.10X10.70	374.45

Sl. No.	Location	Isolates	Colony Colour	Colony Growth	Type of margin	Margin colour	Growth in mm	Sporulation	Size of conidia (μm) (Length X Breadth)	Dry mycelial weight (mg)
42	Bentval	CI-42	Dark gray to black	Smooth	Regular	Black	80	+++	17.70X6.70	324.88
43	Udupi	CI-43	Dark brown	Fluffy raised	Irregular	Brown	70	++	17.60X10.50	256.44
44	Karkal	CI-44	Medium gray	Raised	Irregular	Black	60	++	16.10x8.60	230.47
45	Mysore	CI-45	Light gray	Flat	Regular	Brown	80	+	15.30x11.50	361.85
46	Nanjangud	CI-46	Black	Smooth	Regular	Black	80	+++	17.30X6.00	223.54
47	Nanjangud	CI-47	Medium brown	Flat	Irregular	Brown	50	++	16.6x10.00	189.45
48	T.Narshipura	CI-48	Dark gray to black	Smooth	Regular	Black	80	+++	15.90x7.70	451.26
49	Chamarajanagar	CI-49	Medium gray	Fluffy	Regular	Gray	80	++	15.50X7.70	460.32
50	Yelandur	CI-50	Light gray	Smooth	Regular	Gray	50	+	18.40X12.00	350.91
51	Kollegal	CI-51	Dark gray	Fluffy raised	Regular	Brown	80	+++	16.30X9.00	366.80
52	Kollegal	CI-52	Dark gray	Fluffy raised	Irregular	Gray	90	+++	17.40X8.20	480.42
53	Mandya	CI-53	Dark gray	Fluffy raised	Irregular	Black	90	++++	18.40X9.60	446.81
54	Pandavpur	CI-54	Medium gray	Smooth	Regular	Brown	80	++++	12.60X7.20	382.64
55	Pandavpur	CI-55	Medium gray	Smooth	Irregular	Brown	60	+++	17.00X10.60	356.20
56	Malavalli	CI-56	Light gray	Smooth	Irregular	Gray	80	++++	16.40X11.90	288.54
57	Malavalli	CI-57	Dark gray to black	Flat	Regular	Black	90	++++	14.70X9.30	367.26
58	Ramanagar	CI-58	Dark gray to black	Fluffy raised	Regular	Black	90	++++	18.40X8.90	451.86
59	Kanakpur	CI-59	Dark gray to brown	Flat	Regular	Brown	90	+++	14.10X8.80	466.23
60	Kanakpur	CI-60	Dark brown to black	Flat	Regular	Brown	90	++	16.60X9.80	391.56

-: no sprulation, + : poor [1-10 conidia/microscopic field (10X)], ++ : fair[11-30 conidia/microscopic field (10X)], +++ : good[31-50 conidia/microscopic field (10X)], ++++ : excellent[>50 conidia/microscopic field (10X)]

3.6 Discussion

3.6.1 Morphological variability

The pathogen *C. lunata* put forth moderately rapid growth, covering the agar plate within 6-10 days. All the sixty isolates showed considerable variability with respect to colony characters, colony diameter, sporulation, size of conidia, mycelium width and dry mycelium weight [3]. The colony was sparse to dense, light grey to dark black, fair to fast growing, Excellent sporulation was (> 50 conidia per microscope field) exhibited by isolates CI-1, 2, 6, 15, 16, 20, 21, 25, 34, 35, 53, 54, 56, 57 and CI-58, while poor sporulation (<1-10 conidia per microscope field) was noticed in CI-17, 19, 28, 30, 45 and CI-50, maximum size of conidia was observed in CI-22 (20.30 μm long \times 10.90 μm wide) followed by CI-25 (19.80 μm long \times 9.10 μm wide) [4]. Minimum size of conidia was found in CI-54 (12.60 μm long \times 7.20 μm wide), maximum dry mycelium weight was observed in CI-15 (482.22 mg) followed by CI-52 (488.42 mg) and CI-59 (466.23 mg). Similar description was given by Mathur and Sarbhoy [5]; CHANG Jia-ying et al. [6].

Similarly, Haq et al. [7] found greater mycelial growth of *A. alternata*, *C. lunata*, *M. phaseolina* and *R. solani* on glucose peptone agar and Brown's agar than on potato dextrose agar and oat meal agar. Aurangzeb et al. [8] found potato dextrose agar to be best medium for the mycelial growth and sporulation of *F. moniliforme* followed by Wakasman's agar, basal medium, Czapek's Dox agar and Richard's medium. Patel [9] found potato dextrose agar superior for the growth and sporulation of *A. alternata* followed by potato carrot sucrose agar.

Morphological characterization of *Curvularia* species and related species is the classic approach of identification which could be aided with molecular characteristics.

4. CONCLUSION

Based on morphological and cultural, the fungus identified with high incidence associated with seeds collected in different agricultural producing regions was *Curvularia lunata*. This fungus is transmitted to plants via seeds, is pathogenic. Its gives information regarding virulence characteristic nature of pathogen to particular region.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sumangala K, Patil MB, Nargund VB, Arun S, Prashanti S, Uma K. Status and distribution of rice grain discoloration in north eastern Karnataka. Karnataka J. Agric. Sci. 2010;23: 804-805.
2. Bag MK. In symposium on microbial diversity and seed health. Nov. 29-30, 2007, BCKV Kalyani, West Bengal. 2007; 2.
3. Nor Azizah Kusai, Madiah Mior Zakuan Azmi, Shahrizim Zulkifly, Mohd Termizi Yusof, Nur Ain Izzati Mohd Zainudin. Morphological and molecular characterization of *Curvularia* and related species associated with leaf spot disease of rice in Peninsular Malaysia. Rend. Fis. Acc. Lincei. 2015;27(2). DOI: 10.1007/s12210-015-0458-6
4. Yuvarani R, Brindhadevi S, Thiruvudainambi S, Theradimani M, Vanniarajan C, Renuka R. Morphological and molecular characterization of *Curvularia* species associated with grain discoloration of rice in Tamil Nadu. The Pharma Innovation Journal. 2021;10(10): 1791-1796.
5. Mathur SB, Sarbhoy AK. Physiological studies on *Alternaria alternata* from sugarbeet. Indian Phytopath. 1977;30: 384-387.
6. Chang Jia-ying, LIU Shu-sen, Shi Jie, Guo Ning, Zhang Hai-jian, Chen Jie. A new *Curvularia lunata* variety discovered in Huanghuaihai Region in China. Journal of Integrative Agriculture. 2020;19(2):551-560.
7. Haq IU, Khan SM, Ahmad R. Physiological studies on six fungal isolates from rotted roots of cotton. Pak. J. Phytopath. 1999;11(2):173-177.
8. Aurangzeb M, Shafqat A, Ilyas B, Gill MA. Physiological studies on *Fusarium moniliformae* Sheld, the causal organism of bakanae disease of rice. Mycopath. 2003;1(1):49-52.

9. Patel JP. Investigations on leaf spot of green gram (*Phaseolus aureus* Roxb.) caused by *Alternaria alternata* under South Gujarat conditions. M.Sc. (Agri). Thesis, G. A. U., S. K. Nagar (India). 2003; 87-89.

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