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Occurrence of ginger foliar disease complex epidemics: *Xanthomonas* leaf blight, *Proxipyricularia* blast and *Colletotrichum* leaf spot in the Western Ghats of Karnataka, India

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ABSTRACT: Ginger (*Zingiber officinale* Roscoe) is one among the most valued and widely cultivated spice crops in the world. The major limitation to the production of ginger is its susceptibility to a wide range of pests and diseases. Intensive roving survey was conducted to know the disease severity and exact cause of ginger foliar disease complex in seven talukas *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura of Shivamogga district, Karnataka during June to July 2025. From this study we found three pathogens responsible for epidemics – Bacterial leaf blight caused by *Xanthomonas axanopodis pv. zingiberis* is the first report from India and world, *Proxipyricularia zingiberis* (=*Pyricularia zingiberis*) cause blast and *Colletotrichum zingiberis* cause leaf spot. Though, all the three pathogens present in 66 fields in 59 villages of seven talukas in moderate to severe form but leaf spot was in low to moderate form.

Key words: Ginger, *Xanthomonas* leaf blight, *Proxipyricularia* blast, *Colletotrichum* leaf spot, epidemics

INTRODUCTION

India is renowned throughout the world as "spice bowl" due to production and export of spices. The spices contribute 6.0 per cent to total export and 9.00 per cent to agriculture export (Spice Board India, 2024). Ginger (*Zingiber officinale* Roscoe) is a valuable rhizomatous spice crop known for its distinctive flavor, pungency and aroma. It is utilized in various products *viz*., wine, beer, carbonated beverages, cordials, confectionery, pickles and pharmaceuticals. Ginger belongs to Zingiberaceae family, it thrives in regions like tropical and subtropical (Kavitha & Thomas, 2008).

As per Dohroo *et al*. (2012), predominantly ginger producing countries include India, China, Sierra Leone, Australia, Fiji, Indonesia, Nigeria, Bangladesh, Jamaica, and Nepal. India stands as the largest global producer of ginger, contributing approximately one-third of the world's total production (Kumar *et al.,* 2014). India is a leader in term of area and production of Ginger. In India, during 2023-2024 ginger production was 2503 thousand metric tons with an area of 210 thousand hectare. Major ginger producing states are Madhya Pradesh, Rajasthan, Gujarat, Karnataka, Telangana, Andhra Pradesh, Maharashtra, Orissa, Assam, Uttar Pradesh, West Bengal, and Kerala (Anonymous, 2024).

Ginger holds significant economic and cultural importance in Karnataka, particularly in the hilly Malenadu region encompassing Shimoga, Kodagu, Chikkamagaluru, North canara and parts of Mysuru as well as Bidar and Haveri. Karnataka ranks among India's leading ginger-producing states, contributing substantially to national spice output. Favourable agro-climatic conditions, rich lateritic soils, adequate monsoon rainfall, and moderate temperatures have traditionally supported high yields and good-quality rhizomes (Mahesha *et al*., 2020).

In Karnataka, ginger is planted in the month of May-June as rainfed crop immediately after the pre-monsoon showers. It starts sprouting in June and tillering continues until in the late in the season. High soil moisture and optimum temperature (25-30^{0}C) prevailing throughout the growing season. Moreover,

young tissues of the host which *Pythium* prefers to infect are also readily available and the pathogen spreads though soil water by means of zoospores, hyphal fragments and infected planting materials. The pathogen associated with rhizome rot complex disease of ginger in Karnataka includes *Pythium aphanidermatum* (soft rot), *Ralstonia solanacearum* (bacterial wilt), *Fusarium solani* (yellows), *Sclerotium rolfsii* (Sclerotium rot) and *Meloidogyne incognita* (root knot).

Due to variation in weather conditions *viz*.,relative humidity (90-95%), night temperature (15-22□), morning dew, cloudy weather, less plant spacing, high and drizzling rainfall, rainfall with intermittent sunshine as well as high dose application of nitrogenous fertilizers leads to develop epidemics of new foliar disease complex in ginger (*Xanthomonas* leaf blight, *Proxipyricularia* blast and *Colletotrichum* leaf spot) in Shivamogga and other ginger growing districts of Karnataka, Because of severity of foliar disease complex roving survey was conducted during 2025 June and July in seven talukas of Shivamogga district where ginger is grown widely by the farmers. Further, characterized the pathogens and confirmed their pathogenicity.

MATERIALS AND METHODS

A roving intensive survey was conducted from June - July 2025 to know the incidence of epidemics of ginger foliar disease complex (*Xanthomonas* leaf blight, *Proxipyricularia* blast and *Colletotrichum* leaf spot). During survey 66 ginger fields in 59 villages were covered in seven talukas of Shivamogga district *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura of Karnataka state. The survey was conducted by Zonal Agricultural Horticulture Research Station, Navile, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga.

Table 1. Severity of foliar diseases of ginger in Shivamogga district during June to July 2025.

Taluk	Village	Severity of foliar diseases caused by		
		***Xanthomonas* sp.**	***Proxipyricularia* sp.**	***Colletotrichum* sp.**
Bhadravathi	Anaveri	+++	+++	+
	Antaragange	++	++	+
	Arabillachi	+++	++	+
	Kaimara	++	+++	+
	Holaluru	+++	++	+
	Balekatte	++	+++	+
	Devarahalli	+	++	+
	Holehonnuru	++	+	++
Hosanagara	Hosanagara	++++	++++	+
	Nitturu	++++	++++	+
Sagar	Gowthampura	++++	+++	+
	Gowthampura	+++	+++	++
	Hosanahalli	++++	+++	+
	Iruvakki	+++	+++	++
	Kannuru	++++	+++	+
	Kannuru	+++	+++	+
	Narasipura	++++	++	++
	Shuntikoppa	+++	+++	+

	Siddapura	++++	++	+
	Thangalwadi	++++	+++	++
Shikaripura	Anavatti	+++	+++	+
	Anavatti	+++	+++	++
	Anavtti	++	+++	+
	Anjanapura	++	+++	+
	Hosuru	+++	++	+
	Isssuru	++	+++	+
	Issuru	++	++	+
	Kalmane	++	++	+
	Kaniya	++	++	+
	Kaniya	++	+++	+
	Narasapura	+++	++	+
	Shettihalli	++	+++	+
	Shiralakoppa	++	++	++
	Shiralakoppa	+++	++	+
	Shiralakoppa	+++	+++	+
	Shivaji kaniya	++	+++	+
	Shivaji kaniya	++	++	+
	Thogarsi	++	++	+
	Udugani	++	++	+
Shivamogga	Abbalagere	++	++	+
	Agasavalli	++	++	+
	Ayanuru	++	++	+
	Basavana ganguru	++	++	+
	Basavapura	++	++	+
	Beeranahalli	++	+++	+
	Bikkona halli	++	+++	+
	Byranakoppa	++	++	+
	Hosalli	++	++	+
	M.Anasavadi	+++	++	+
	Savalanga	++	++	++
Soraba	Arekoppa	++	++	+
	Balekoppa	++	+++	+
	Hale soraba	++	+++	+
	Heggodu	++	++	+

	Hosakoppa	+++	++	+
	Hosalli	++	++	++
	Kumsi	++	+++	+
	Kuppe	++	+++	++
	Kuppe gudda	++	+++	+
	Kuppegudda	++	++	++
	Ulavi	++	++	+
Thirthahalli	Alase	++	++	+
	Araga	++	++	+
	Balehalli	++	++	+
	Kavaledurga	+++	++	+
	Umblebaylu	++	++	+
	Bejavalli	+++	+++	+

Note: Disease severity

+ Low (up to 5 % leaf area affected); ++ Medium (up to 6 to 20 % leaf area affected) +++ High (up to 21 to 40 % leaf area affected) ++++ Very high (> 40 % leaf area affected)

Based on the *Proxipyricularia* blast (*Proxipyricularia zingiberis*) symptoms explained by Klaubauf *et al*. 2014 and Nguyen Chi Hieu *et al*., 2021 and *Colletotrichum* leaf spot (*Colletotrichum zingiberis*) explained was first reported by Sundararaman (1922) from the Godavari district of Andhra Pradesh and the species *C. zingiberis* was identified by Butler & Bisby (1931) and the Bacterial leaf blight (*Xanthomonas* axanopodis pv. *zingiberis*) were recorded based on water soaked lesions on leaves and stem regions.

During the study, affected ginger leaf and stem regions were systematically examined for the appearance of *Xanthomonas* leaf blight, *Proxipyricularia* blast and *Colletotrichum* leaf spot affected symptoms and their occurrence were recorded visually and converted to severity for individual disease as given in Table 1.

Isolation, morphology, culture and pathogenicity of *Colletotrichum zingiberis* was followed the standard procedure made by Darshana, *et al.,* 2014. Isolation, morphology, culture and pathogenicity of *Proxipyricularia zingiberis* was followed the standard procedure made by Duong Thi Nguyen *et al.,* 2022, Isolation, morphology, culture and pathogenicity of *Xanthomonas axanopodis pv. zingiberis* was followed the standard procedure made by Praveen *et al.,* 20219

RESULTS AND DISCUSSION

During intensive roving survey of ginger foliar disease complex, observed presence of different types of symptomatology in seven talukas of Shivamogga district. From our study we found presence of three types pathogens producing different symptoms *viz*., Bacterial leaf blight caused by *Xanthomonas axanopodis* pv. *zingiberis*, Blast caused by *Proxipyricularia zingiberis* and leaf spot caused by *Colletotrichum zingiberis*.

Bacterial leaf blight

Symptoms produced by *Xanthomonas axanopodis* pv. *zingiberis*

Xanthomonas leaf blight of Ginger

Symptoms: Small, irregular water soaked lesions on leaves of ginger both on upper and lower surfaces. Under favorable weather conditions the water soaked lesions enlarges and completely covered the foliage of ginger and caused blighted or burnt appearance in field conditions (Fig. 1a). The bacterial pathogen was confirmed under laboratory conditions by ooze test (Fig. 1b), Grams stain test (Plate 1c) and 3% KOH test (Fig. 1d), Isolation and purification from leaf tissues on nutrient agar (Fig. 1e) and proving the Koch's postulates (Fig. 1f).

Small irregular water soaked lesions on leaves of ginger. Under favorable climatic conditions the water soaked lesions enlarges and completely covered the foliage of ginger and causes blighted or burnt appearance in field conditions and also observed the water soaked lesions stem regions just above the soil region (Fig. 1a). Though, conducted Bacterial ooze test to confirmation and after few minutes white milky opaque exudation came out from water soaked lesions of ginger leaf and stem regions (Fig. 1b) and the symptoms of *Xanthomonas axanopodis* pv. *zingiberis* leaf blight is first report from India and world.

Cultural, morphological, biochemical and Gram stain characters of *Xanthomonas axanopodis* pv. *zingiberis*

We observed Yellow mucoid colonies on Nutrient agar after 36 hours of isolation (Fig. 2c), The isolated bacterial pathogen tested with three Percent potassium hydroxide (3% KOH) biochemical test and gave string or thread like structure (Fig. 1d). Apart from this, bacterial culture shows pink colour to gram stain reaction (Fig. 2e). Further, also proved Koch's postulates to test bacterial culture (Fig. 2f), after fourth day small water soaked lesion appeared on leaves of ginger (Fig. 2g).

a. Development of water soaked lesion

b. Foliage covered with water soaked lesions

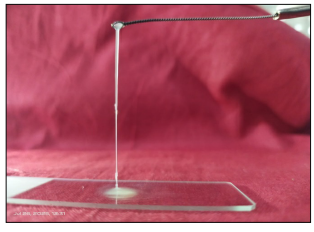
c. Water soaked lesions on stem

d. Blighted appearance

e. Severely affected ginger leaves

Fig. 1. *Xanthomonas axanopodis* pv. *Zingiberis* leaf blight symptoms of Ginger

a. Bacterial ooze test



b. 3% KOH test – showing string/thread like

c. Grams staining – Red color (G-ve)

d. *Xanthomonas* culture on Nutrient Agar

Fig. 2. Xanthomonas axanopodis pv. Zingiberis laboratory study

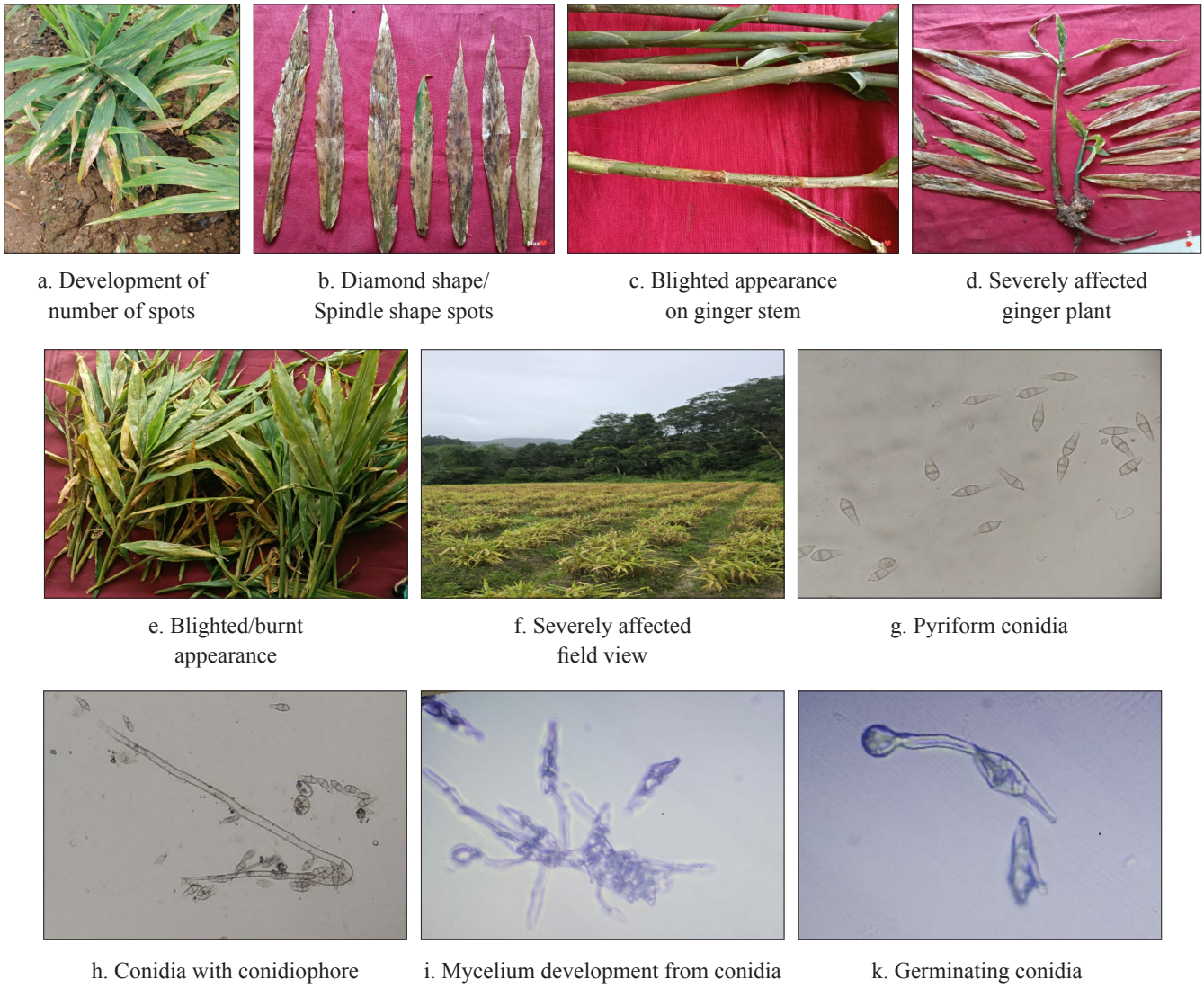
Results of survey of seven talukas of Shivamogga district presented in Table 1 and Fig. 2. *Xanthomonas axanopodis* pv. *zingiberis* leaf blight present in all the 82 surveyed villages from moderate to severe form and enhancing the disease severity in short period of time under favorable weather conditions. All seven talukas *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura prone to more severity of bacterial pathogen.

Symptoms produced by *Proxipyricularia zingiberis*

***Proxipyricularia* blast**

On the ginger leaf and stem regions observed small black or olive green spots initially and under favorable weather conditions spots converted into diamond or spindle shape and also observed small sclerotial bodies later the spots coalesce and causes blast or drying of the foliage (Fig. 3a). *Proxipyricularia* fungal pathogen was confirmed by isolation on Potato Dextrose Agar and purification by hyphal tip method on 2% agar (Fig. 3b), Sectioning of diamond/spindle shape leaf tissues and observed pyriform conidia with conidiophore (Fig. 3c) and proved Koch's postulates (Fig. 3d).

On the ginger leaf and stem regions observed small black or olive green spots initially and under favourable weather conditions, spots converted into diamond or spindle shape and also observed small sclerotial bodies afterwards the spots coalesce and causes blast or drying of the foliage (Fig. 3a) and from our study the symptoms of *Proxipyricularia zingiberis* blast is first report from India.

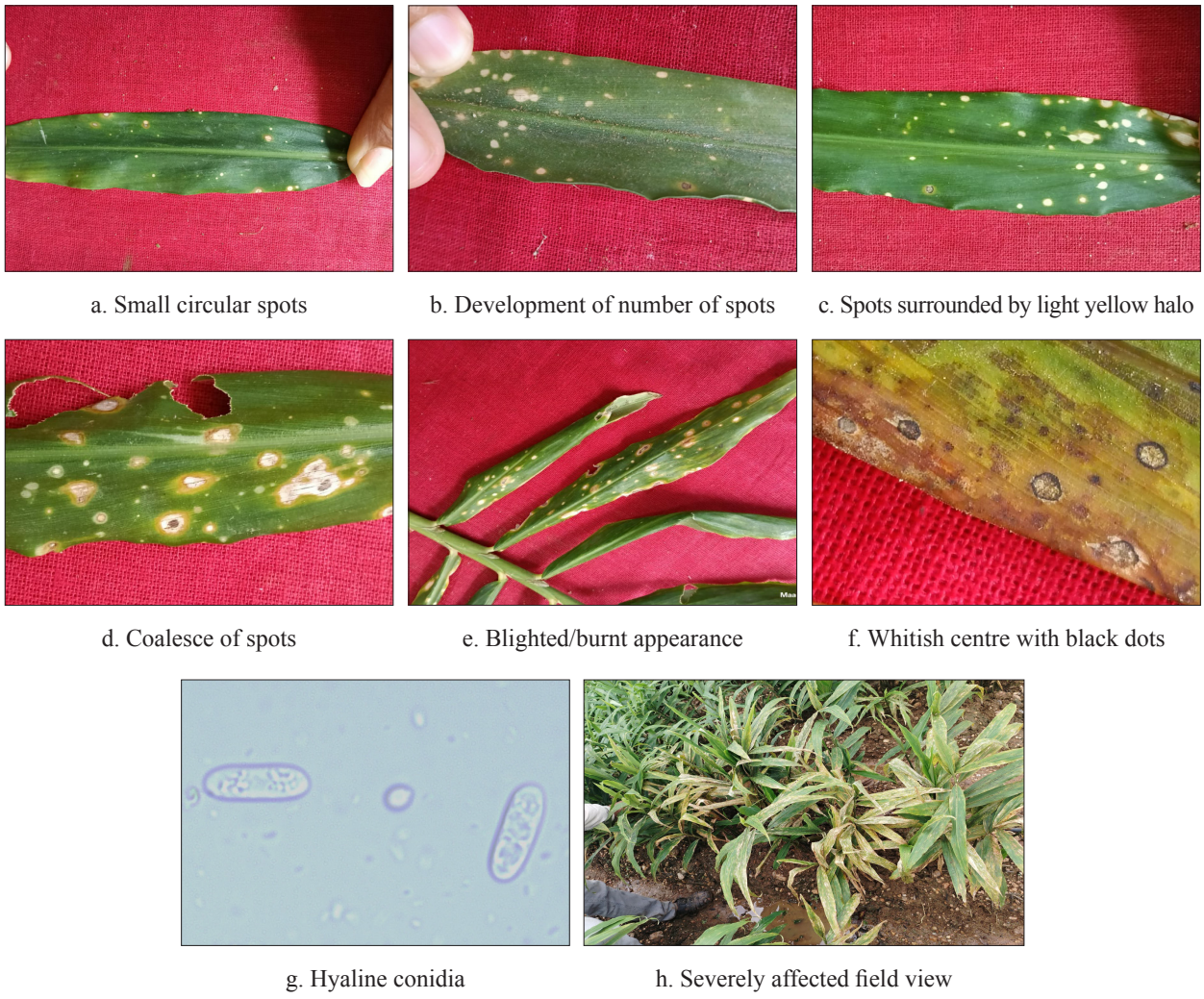


a. Development of number of spots | b. Diamond shape/ Spindle shape spots | c. Blighted appearance on ginger stem | d. Severely affected ginger plant

e. Blighted/burnt appearance | f. Severely affected field view | g. Pyriform conidia

h. Conidia with conidiophore | i. Mycelium development from conidia | k. Germinating conidia

Fig. 3. *Proxipyricularia zingiberis* Blast symptoms of Ginger



a. Small circular spots b. Development of number of spots c. Spots surrounded by light yellow halo

d. Coalesce of spots e. Blighted/burnt appearance f. Whitish centre with black dots

g. Hyaline conidia h. Severely affected field view

Fig. 4. *Colletotrichum zingiberis* leaf spot symptoms and of Ginger

Cultural and Morphological characters of *Proxipyricularia zingiberis*

Initially whitish mycelia mat growth observed on Potato Dextrose Agar, after utilisation of carbon source the pathogen converted into black mycelia. By blast affected ginger leaf tissue sectioning observed two septate (3 celled) pyriform conidia and septate mycelium (Fig. 2b).

Results of survey of seven talukas of Shivamogga district presented in Table 1 and Fig. 2. *Proxipyricularia zingiberis* blast presented in all the 82 surveyed villages from moderate to severe form and enhancing the disease severity in short period of time under favourable weather conditions. All seven talukas *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura prone to more severity of blast pathogen. The present study was agreement with Nishikado 1917 and Kato *et al*. 2000 ICAR- IISR report in Kodagu district of Karnataka (*Anon*. 2025). *Proxipyricularia zingiberis* is phylogenetically distant from *Pyricularia* although morphologically, it appears similar, with medium brown conidiophores and a terminal and intercalary denticulate rachis, and subhyaline, 2-septate, obclavate conidia. Isolates of *P. zingiberis* from *Zingiber mioga* and *Z. officinale* are able to infect plants, but not *Oryza*, *Setaria* or *Panicum* spp. Nishikado (1917) regarded the fungus from Zingiber as genetically distant from *Pyricularia* species isolated from rice or other Poaceae, as well as (Kato *et al*. 2000) using RFLP patterns and (Hirata *et al*. 2007) using multilocus sequence analysis.

Symptoms produced by *Colletotrichum zingiberis*

***Colletotrichum* leaf spot**

On the ginger leaf observed small spots initially and later the spots surrounded by light yellow halo and cover the foliage of ginger (Fig. 4a). *Colletotrichum* fungal pathogen confirmed by isolation on Potato Dextrose

Agar and purification by hyphal tip method on 2% agar (Fig. 4b), sectioning of leaf spot tissues and observed hyaline single celled conidia with oil globules (Fig. 4c) and proved Koch's postulates (Fig. 4d).

On the ginger leaf observed small spots initially and later the spots surrounded by light yellow halo and cover the foliage of ginger (Fig. 4a). While, according to Sundararaman (1922), Colletotrichum leaf spot in India was characterized with small round to oval, light yellow spots on leaves and leaf sheaths, which gradually increase in size and coalesce to form large discoloured areas. The infected areas often dry up at the center, forming shot holes. However, the symptoms observed in the present investigation were in agreement with the earlier reports. Colletotrichum leaf spot was first reported by Sundararaman (1922) from the Godavari district of Andhra Pradesh and the species *C. zingiberis* was identified by Butler & Bisby (1931).

Cultural and Morphological characters of *Colletotrichum zingiberis*

Colletotrichum zingiberis produce whitish mycelium afterwards brown ash color on Potato Dextrose Agar (Fig. 3b), by sectioning of leaf spot tissues and observed dumble shaped conidia with oil globules (Fig. 3c). Results of survey of seven talukas of Shivamogga district presented in Table 1 and Fig. 4. *Colletotrichum zingiberis* leaf spot present in all the 82 surveyed villages from low to moderate form. All seven talukas *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura *Colletotrichum zingiberis* leaf spot is present. The present investigation was agreement with Darshana *et al*. 2014, Colour of the colony varied from white to dull grey and considerable variation was observed in the growth rate of the isolates. The conidial shapes varied with regions and were cylindrical with tapering ends, cylindrical, elliptical or dumbbell, whereas.

CONCLUSION

Intensive roving survey was conducted on epidemics of ginger foliar disease complex in seven talukas *viz*., Shivamogga, Sagar, Soraba, Bhadravathi, Hosanagara, Thirthahalli and Shikaripura of Shivamogga district in 82 farmer fields to know the severity. From this study we identified three diseases *viz*., *Proxipyricularia zingiberis* blast is first report from India and *Xanthomonas axanopodis* pv. *zingiberis* leaf blight is first report from India and world as well as *Colletotrichum zingiberis* leaf spot

REFERENCES

Anonymous. 2024. Major spice state wise area production Spices Board. 1-2 pp.

Butler, E. J. and Bisby, G. R. 1931. The Fungi of India. SCI. Monogr. 1. Imperial Council of Agricultural Research. India.

Dohroo, N. P., Kansal, S. and Ahluwalia, N. 2012. Status of soft rot of ginger (*Zingiber officinale* Roscoe). Department of Vegetable Science, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, HP.Hirata, K., Kusaba, M., Chuma, I. 2007. Speciation in *Pyricularia* inferred from multilocus phylogenetic analysis. *Mycological Research,* **111**: 799–808.

Kato, H., Yamamoto, M. and Yamaguchi, O. T., 2000. Pathogenicity, mating ability and DNA restriction fragment length polymorphisms of *Pyricularia* populations isolated from *Gramineae, Bambusideae* and *Zingiberaceae* plants. *Journal of General Plant Pathology,* **66**: 30–47.

Kavitha, K. and Thomas, J. 2008. *Zingiber officinale*: A Review of its Production, Uses, and Medicinal Benefits. *Agricultural Reviews*.

Kumar, R., Singh, V. and Chauhan, P. 2008. Ginger production in Uttar Pradesh: A review. *Horticulture Journal of India*, **12(2)**:115–120.

Mahesha, H.S.2020. Integrated management of rhizome rot complex in ginger, Ph.D. Thesis, University of Agricultural Sciences Dharwad, Karnataka, India.

Nishikado, Y. 1917. Studies on the rice blast fungus, (I). *Berichte des Ohara Instituts für Landwirtschaftliche Forschungen* **1**: 171–218.

Klaubauf, S. Tharreau, D. Fournier, E. Groenewald, J.Z. Crous,P.W. de Vries, R.P. and Lebrun, M. H. 2014. Resolving the polyphyletic nature of *Pyricularia* (*Pyriculariaceae*). *Studies in Mycology,* **79**: 85–120.

Sundararaman, S. 1922. A new ginger disease in Godavari district. Mem. Dept. Agri. India (Bot Ser.) **11**: 209–217.

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