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SURVEY AND DISEASE PREVALENCE OF BASAL ROT OF ONION IN NORTH WESTERN ZONES OF TAMIL NADU

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ABSTRACT

Onion (*Allium cepa* L.) is an economically important vegetable crop that is severely affected by Fusarium basal rot, caused by *Fusarium oxysporum* f. sp. *cepae* . The present study was conducted during 2025–2026 to assess the incidence, morphological variability, and pathogenicity of FOC isolates associated with onion basal rot in major onion growing tracts of North Western zonest. A fixed plot survey was carried out in Berigai, Athimugam, Bagalur, Nallampalli, Sivadi, Kovilur, and Bukkasagaram villages. Disease incidence ranged from 49.64 to 74.24 per cent, with the highest incidence recorded at Athimugam (74.24%) and the lowest at Bukkasagaram (49.64%). Seven Fusarium isolates were collected and Morphological characterization revealed variation among isolates with respect to colony morphology, mycelial growth, and sporulation. All isolates produced oval to round microconidia, falcate macroconidia, and both terminal and intercalary chlamydospores. Pathogenicity was confirmed, among the seven isolates tested, FOC 4 was identified as the most virulent, recording the highest disease incidence (70.83%) whereas FOC 1 exhibited the lowest pathogenicity (41.66 %). These findings provide valuable baseline information on the distribution and diversity of onion basal rot pathogen populations in Tamil Nadu and may aid in developing effective disease management strategies for sustainable onion production.
***Keywords*:** *Allium cepa*, Fusarium basal rot, pathogenicity

Introduction

Onion (*Allium cepa*) is one of the most widely cultivated vegetable crops in the world, belonging to the family Amaryllidaceae. It is an essential ingredient in global cuisine, valued for its distinctive flavor and aroma. The plant develops as an underground bulb composed of multiple fleshy layers, which form the edible portion. Onions are available in several varieties, including red, white, and yellow types, each offering a range of flavors from mild sweetness to sharp pungency. When cut, onions release sulfur-containing compounds that can irritate the eyes and cause tearing. Nutritionally, onions are rich in vitamin C, vitamin B6, and antioxidants, making them beneficial for human health. They are known to boost immunity, support heart health, and exhibit antibacterial properties. Their culinary versatility is remarkable they can be consumed raw in salads, cooked in curries, fried, roasted, or used as a base for soups and sauces. Due to these qualities, onions are considered a staple ingredient in many cuisines worldwide.

In India, onion cultivation plays a significant agricultural role, and Tamil Nadu contributes moderately to the country's total production. The state typically ranks between 8th and 10th among onion-producing states. The area under onion cultivation in Tamil Nadu remains relatively stable at around 30,000 to 40,000 hectares (Anonymous 2023-24). Annual production is estimated at approximately 4 to 5 lakh tonnes, with gradual improvements attributed mainly to better farming practices rather than expansion of cultivated area. The average productivity ranges from 10 to 12 tonnes per hectare (Anonymous 2023-24)., which is moderate compared to leading states such as Maharashtra and Gujarat.

Within Tamil Nadu, onion cultivation is concentrated in specific districts rather than being evenly distributed. Major onion-producing districts include Perambalur, Namakkal, Salem, Tiruchirappalli, Dindigul, Theni, Coimbatore, and Tirunelveli, where favorable soil and climatic conditions support higher production. Among these, Perambalur and Namakkal have relatively larger cultivation areas, while districts like Dindigul and Theni are known for higher productivity. In other districts such as Ariyalur, Thanjavur, and Tirupathur, onion is cultivated on a smaller scale as part of diversified horticulture (Anonymous, 2024).

Despite its importance, onion (*Allium cepa*) is susceptible to a wide range of diseases caused by fungi, bacteria, and viruses, which can significantly affect yield and quality. Common fungal diseases include basal rot, purple blotch, downy mildew, and damping-off. Among these, basal rot is one of the most destructive diseases affecting onion ecosystem both field and storage (Mishra *et al*., 2014: Haapalainen *et al*., 2016: Ramírez *et al.*, 2019: Kalman *et al*., 2020). Onion basal rot or Fusarium basal rot of onion caused by *F. oxysporum f. sp. cepae* is among the most destructive onion diseases worldwide, causing yield losses more than 50 percent (Lacyn & Roberts, 1982). It is caused by the soil-borne fungus *Fusarium oxysporum* f. sp. *cepae*, which infects plants through the roots and basal plate. The disease typically manifests as yellowing and drying of leaves from the tips downward, accompanied by root decay and rotting of the basal portion of the bulb. Infected bulbs often show brown discoloration and may completely rot both in the field and during storage. Basal rot is more severe in warm soil conditions and poorly drained fields. With this background, research was conducted on the survey and severity of onion basal rot disease incidence in different onion growing tracts of North western zones of Tamil Nadu.

Materials and Methods

Survey and collection of Onion basal rot infected sample:

A survey on the disease prevalence of Fusarium basal rot in different districts of Noth western zones was to be conducted in 2026. The affected samples were collected from different areas and infected samples collected were kept in a clean polythene bag and labelled with location information and taken to the Plant Pathology laboratory of Adhiyamaan College of Agriculture and Research, Athimugam. The samples were used for microscopic observation, isolation, identification, purification, and pathogenicity test. Disease incidence was calculated by counting the total number of infected plants in each field. The percent disease incidence of Onion fusarium wilt was calculated according to the formula given by (Mayee and Datar, 1986).

Percent Disease Incidence (PDI)

$$= \frac{\text{Number of wilted plants}}{\text{Total number of plants observed}} \times 100$$

Isolation and maintenance of Pathogen

The base of the bulb of a diseased plant was cut to reveal the infected tissues. The infected tissue was surface sterilized by soaking in 0.1% sodium hypochlorite solution for 5 minutes. The tissue was dried on paper towels. Using a sterile technique, a thin (2-4 mm thick) tissue was cut out from basal portion of the bulb. 4 pieces were placed on PDA plates. The plates were incubated under room temperature for 7 days. Once the fungus had grown sufficiently from the pieces, it was transferred to fresh PDA plates. The plates were incubated for 10-14 days. Colonies of *F. oxysporum* were pigmented with a reddish-purple color and were surrounded by a pinkish white aerial mycelium.

Morphological characters

The different isolates of *Fusarium* were grown on PDA medium. Using a sterilized cork borer nine mm pathogen disc was taken from seven-day-old culture and placed at the center portion of the sterilized Petri plate containing 20 ml solidified PDA medium and the plates were incubated at 28±2 ^{0}C for seven days. After the incubation period, the morphological characters of the pathogen were observed like mycelial growth, mycelium colour, colony morphology, conidial shape, conidial size, and conidial development were recorded based on the procedure given by (Leslie and Summerel, 2006).

Koch postulate (Artificial Inoculation)

The pathogenicity of all onion basal rot isolates was confirmed by conducting Koch's postulates under aseptic pot culture conditions (*in-vitro*). Sand, soil, and farmyard manure (FYM) were separately passed through a (2 mm) mesh sieve, sterilized individually, and mixed in a ratio of 1:1:0.5 (sand: soil: FYM). The sterilized potting mixture was transferred into sterilized pots up to a height of 30 cm. The pathogen, mass-multiplied on sand–maize medium, was incorporated into the potting mixture at 5% (w/w) of the total soil weight. Eight healthy onion bulbs were planted in each pot, and the experiment was conducted with three replications along with an uninoculated control. Disease incidence was recorded 25 days after inoculation, and the percent disease incidence (PDI) was calculated for each isolate. The pathogen was subsequently re-isolated from infected plants to fulfill Koch's postulates.

Statistical analysis

In-vitro experiments were carried out under CRD and collected data were statistically analyzed using the Statistical Package for the Social Sciences version 16.0. The collected data with percentage values have been transformed into arc sine values and Critical Differences have been developed at a 5 % level of significance. Using Duncan's Multiple Range Test (DMRT) the means were compared.

Result and Discussion

Survey and incidence of onion basal rot

A fixed plot survey was conducted during 2025-2026 to assess the disease severity of Fusarium basal rot incidence in major onion growing tracts of North western zones *viz.*, Berigai, Athimugam, Bagalur, Nallampalli, Sivadi, Kovilur and Bukkasagaram. In various surveyed areas, seven different Fusarium pathogenic isolates were obtained, the highest wilt incidence (74.24) was recorded in Athimugam. The lowest percent disease incidence (49.64) was recorded in Bukkasagaram (Table 1). Similar findings had been reported by (Shamyuktha *et al*., 2020: Vignesh, *et al*., 2021: Muthukumar *et al*., 2022, Ramachandran *et al*., 2025:) survey was conducted on different onion growing tracts of North Western Zones and reported that, the disease incidence ranged from 11.26 per cent to 60.15 percent respectively (Table 1).

Symptomatology

Initially, infected plants exhibit yellowing of foliage and gradual drying of leaves, followed by wilting. The drying starts from the leaf tips and progresses downward, accompanied by rolling of leaves. Eventually, the entire plant shows complete drying of foliage. The root system collapses and decays due to the production of the toxin fusaric acid by the pathogen. Infected bulbs develop brown to semi soft watery rot along with whitish fungal mycelial growth on the basal portion of onion bulb. During storage, under favourable environmental conditions, white mouldy fungal growth appears on the basal portion of the onion bulbs, leading to decay of the internal scales. Finding from the present study are supported by earlier reports (Anupama, *et al*., 2014: Vijayrao, 2024) (Fig 1).

Morphological characters of different FOC isolates

The various morphological characteristics such as mycelial growth, colony type, micro conidia, macroconidia, chlamydospores, and mycelial growth rate (cm/day) were recorded in all the 7 isolates separately**.** Microconidia and macroconidia produced by 7 isolates of *Fusarium oxysporum* f.sp. *cepae* was observed using a compound microscope. The microconidia were oval and round shaped and the macroconidia were falcate (sickle) shaped. All the isolates are produced by both terminal and intercalary chlamydospores and sometimes inside the macroconidia (Table 2, Fig 2,2a). However, Nath *et al*., 2017: Bektas *et al*., 2019: Malathi *et al*., 2023: Vetrova *et al*., 2024) also reported that *Fusarium oxysporum* f.sp. *cepae* has produced white to pink-colored fluffy mycelial growth and matured mycelium produced micro (single celled & hyaline conidia), macro (3 to 5 septate hyaline conidia under the favorable conditions) and chlamydospores (resting structure under the un favorable conditions). Chlamydospores produced both terminal and intercalary. Similarly, several studies have reported comparable findings (Nelson, 1983; Salam *et al*., 2015; Singh and Singh, 2016; Mandal *et al.*, 2018; Rajendran *et al.*, 2018; Shamyuktha *et al.*, 2020; Yadav and Mishra, 2020; Shin *et al*., 2023).

Pathogenicity test

The pathogenicity of seven isolates of *Fusarium oxysporum* f. sp. *cepae* causing onion basal rot was evaluated under pot culture conditions through artificial inoculation. All seven isolates were found to be pathogenic to onion plants. Among them, isolate FOC 4 recorded the highest disease incidence (70.83%), followed by FOC 7 (58.33%), whereas the lowest disease incidence (41.66%) was observed in isolate FOC 1 (Table 3; Fig. 3). Pathogenicity was confirmed by re-isolating the pathogen from infected plants and comparing the re-isolated cultures with the original isolates, which showed identical characteristics. Since isolate FOC 4 produced the highest disease incidence, it was identified as the most virulent isolate. Similar findings were reported by Davis and Henderson (1937), who confirmed the pathogenicity of the onion basal rot pathogen under controlled conditions. The present results are also in agreement with earlier reports by (Kehr and Davis, 1962: Villevieille,1996: Saxena, 2007: Mhammad *et al*., 2019: Mudiyanselage *et al*., 2009: Muthukumar *et al*., 2022).

Conclusion

The present investigation revealed that the incidence of Fusarium basal rot in onion ranged from 49.64% to 74.24% across different survey locations in North western zones. Among the surveyed areas, Athimugam village recorded the highest disease incidence (74.24%), whereas the lowest incidence (49.64%) was observed in Bukkasagaram village. A total of seven Fusarium isolates were collected from various locations. All isolates produced characteristic microconidia, macroconidia, and chlamydospores. Based on cultural and morphological observations, the study indicated the presence of multiple virulent strains of the pathogen in the surveyed regions. Furthermore, seven distinct genotypes of the onion basal rot pathogen were isolated from different geographical locations, and all exhibited pathogenicity under experimental conditions. Considerable variability among the isolates was observed with respect to their morphological and pathogenic characteristics. The findings of this study provide valuable insights into the diversity and distribution of the pathogen responsible for onion basal rot in Tamil Nadu. These results serve as baseline information for future research and may contribute to the development of effective disease management strategies for onion-growing farmers in the state.

Fig. 1 : Different Types Symptoms Caused by *Fusarium oxysporum* f.sp. *Cepae* under (*In-Vivo*) conditions

Table 1 : Survey and assessment of Onion (*Fusarium oxysporum f.sp. cepae*) basal rot incidence in different Onion growing tracts of North western zones of Tamil Nadu

S. No	Location	Isolates	Latitude/Longitude	Districts	Soil type	Variety/Hybrid	Stage of crop	PDI (%) *
1.	Berigai	FOC1	12.8063°N,77.9717°E	Krishnagiri	Clay loam	Co(on)5	Vegetative stage	(65.32) b
2.	Athimugam	FOC2	12.8207°N,78.0215°E	Krishnagiri	Red sandy loam	Local cultivar	Flowering stage	(74.24) a
3.	Bagalur	FOC3	12.65°N,77.81°E	Krishnagiri	Red loam	Local cultivar	Vegetative stage	(62.08) c
4.	Nallampalli	FOC4	12.008°N,78.082°E	Dharmapuri	Red sandy loam	Co(on)5	Vegetative stage	(53.72) e
5.	Sivadi	FOC5	12.16°N,77.77°E	Dharmapuri	Red sandy soil	Co1	Vegetative stage	(62.98) c
6.	Bukkasagaram	FOC6	12.7256°N,77.9360°E	Krishnagiri	Sandy loam	Local cultivar	Vegetative stage	(49.64) f
7.	Kovilur	FOC7	12.0596°N,78.1231°E	Dharmapuri	Red sandy clay loam	Co(on)5	Flowering stage	(60.00) d
SE (d) = 0.73								
CD (P =0.05) = 0.44								

*Mean of the ten plant treatments means are compared using Duncan Multiple Range Test (DMRT).

Table 2 : Morphological and Cultural Characteristics of *Fusarium oxysporum f.sp.cepae* under *In-vitro* conditions.

Treatments	Colony Morphology	Days For Mycelium Formation	Mycelial Distribution In Media	Mycelium colour Initial	Mycelium colour Later	Days	Micro-conidia	Macro-conidia	Chlamy-dospores
FOC 1	Fluffy White Mycelium Later Brown Colour	7	All Over	Pure White	Brown	3	Single Celled Oval Shape	Septate (3 To 4) Sickle Shape	Thick Walled Single Intercalary
FOC 2	Fluffy White Mycelium Later Blue Colour	8	Fluffy All Over	Pure White	Blue	4	Single Celled Round Shape	Septate (3 To 5) Sickle Shape	Thick-Walled Double Terminal
FOC 3	Fluffy White Colour Later Brown Colour	7	Fluffy All Over Petriplate	Pure White	Brown	3	Single Celled Oval Shape	Septate (2 To 3) Sickle Shape	Thick Walled Single Intercalary
FOC 4	Fluffy White Mycelium Light Blue Colour	7	Profuse Pattern	Pure White	Blue	3	Single Celled Oval Shape	Septate (3 To 4) Sickle Shape	Thick Walled Triple Intercalary
FOC 5	Light Blue Colour Mycelium	8	Spirally Arranged	Light Blue	Blue	4	Single Celled Oval Shape	Septate (3 To 4) Sickle Shape	Thick Walled Intercalary
FOC 6	White Fluffy Mycelium Later Pink Colour	7	Fan Like Pattern	Light White	Brown	3	Single Celled Round Shape	Septate (4 To 5) Sickle Shape	Thick Walled Quadrable Intercalary
FOC 7	White Fluffy Mycelium Later Brown Colour	8	All Over Plate	Pure White	Brown	4	Single Celled Oval Shape	Septate (3 To 4) Sickle Shape	Thick Walled Pentable Terminal

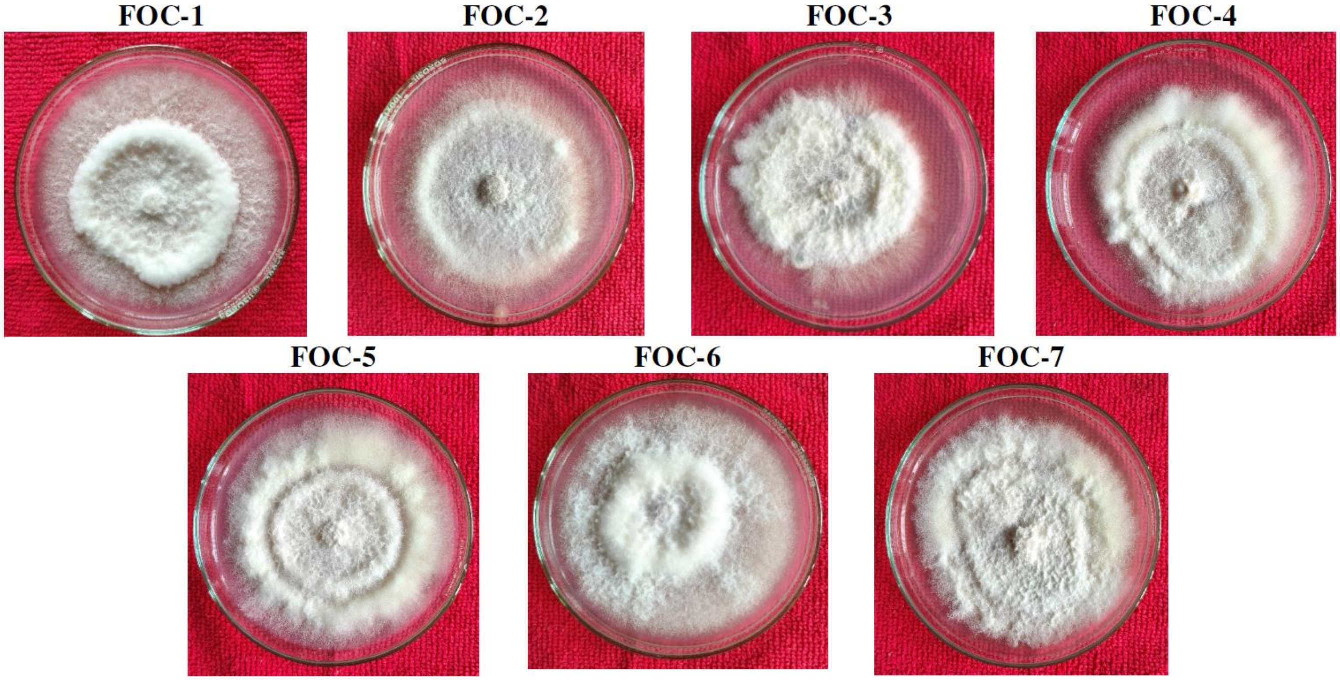

Fig. 2 : Pure culture of Different isolates of *Fusarium oxysporum f.sp.cepae*.

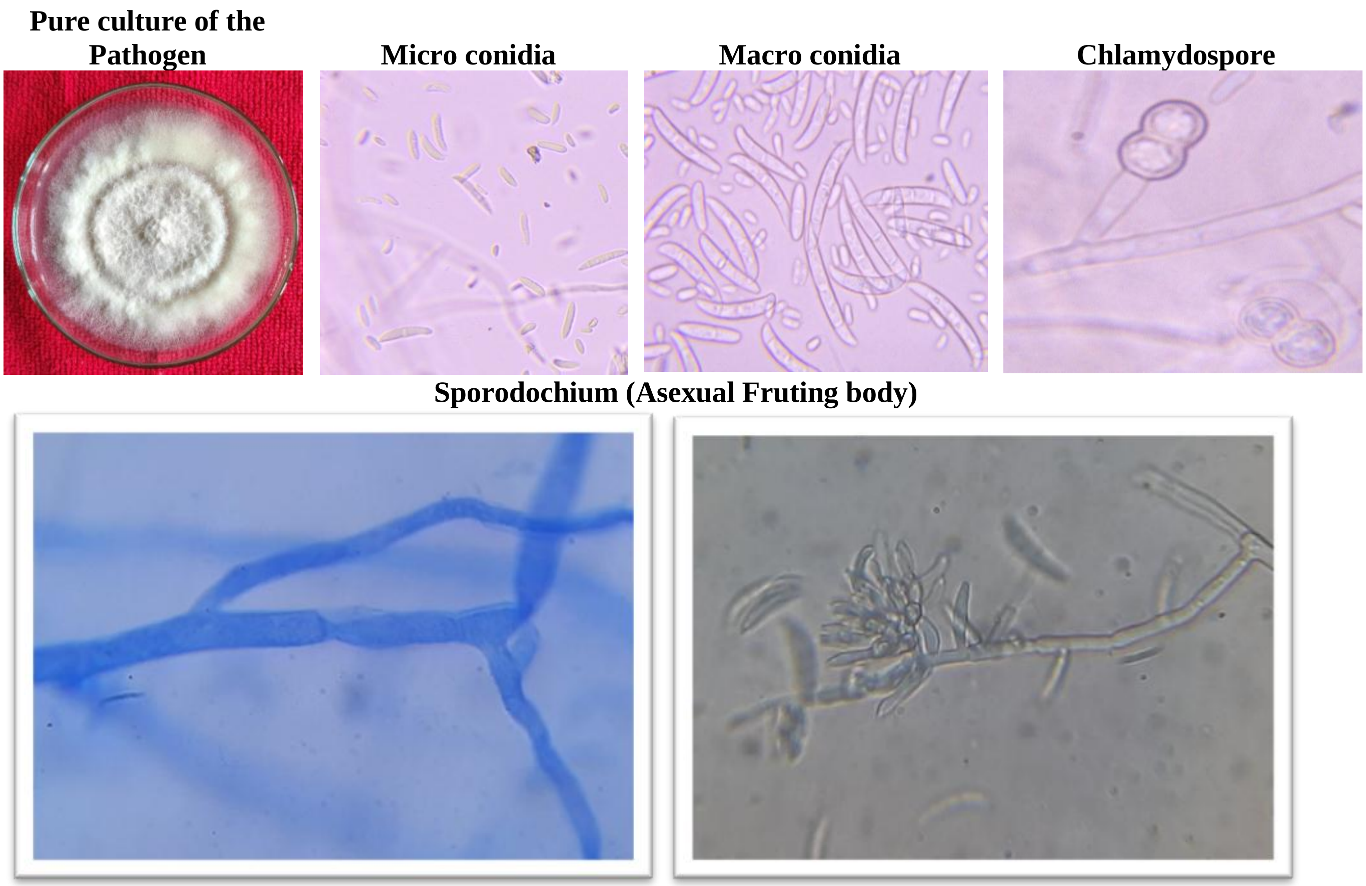

Plate 2a : Morphological and Cultural Characteristics of *Fusarium oxysporum f.sp.cepae* under *In-vitro* conditions.

Table 3 : Pathogenicity or Koch postulate of different isolates of *Fusarium oxysporum* f.sp. *cepae* under pot culture condition.

T.No	Isolates	Wilt incidence (%)
T^{1}	FOC 1	54.10 $(47.58)^{ab}$
T^{2}	FOC 2	41.66 $(40.17)^{b}$
T^{3}	FOC 3	50.00 $(45.00)^{b}$
T^{4}	FOC 4	70.83 $(57.41)^{a}$
T^{5}	FOC 5	50.00 $(45.00)^{b}$
T^{6}	FOC 6	50.00 $(45.00)^{b}$
T^{7}	FOC 7	58.33 $(49.82)^{ab}$
T^{8}	FOC 8	0.0 $(0.28)^{c}$
CD(0.05)		**11.29**

Fig. 3 : Pathogenicity or Koch postulate of different isolates of *Fusarium oxysporum* f.sp. *cepae* under pot culture condition.

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References

Anonymous (2022-23). Agricultural Statistics at a Glance-2022. Department of Agriculture & Farmers Welfare. (www.agricoop.nic.in).

Anonymous (2022-23). India Stat Agri-2022. Horticulture. (indiastatagri.com).

Anonymous (2023-24). National Horticultural Board, Government of India.

Anupama, M.P., Benagi, V.I., Nargund, V.B., Patil, R.V. (2014). Survey of onion basal rot caused by *Fusarium oxysporum f. sp. cepae* in Karnataka. *Karnataka Journal of Agricultural Sciences.* **27**(2), 245–246.

Bektas, I., & Kusek, M. (2019). Phylogenetic and morphological characterization of *Fusarium oxysporum f. sp. cepae* the causal agent of basal rot on onion isolated from Turkey. *Fresenius Environmental Bulletin*, **28**(3), 1733-1742.

Booth, Colin. (1971). *The genus Fusarium*. Kew, UK, Commonwealth Mycological Institute.

Davis, G.N. and Henderson, W.J. (1937). The interrelation of the pathogenicity of *Phoma* and *Fusarium* on onion. *Phytopathology*, **27,** 763-772.

Haapalainen, M., Latvala, S., Kuivainen, E., Qiu, Y., Segerstedt, M., & Hannukkala, A. O. (2016). *Fusarium oxysporum, Fusarium proliferatum* and *Fusarium redolens* associated with basal rot of onion in Finland. *Plant Pathology*, **65**(8), 1310-1320.

Kalman, B., Abraham, D., Graph, S., Perl-Treves, R., Meller Harel, Y., & Degani, O. (2020). Isolation and identification of *Fusarium spp.*, the causal agents of onion (*Allium cepa*) basal rot in Northeastern Israel. *Biology*, **9** (4), 69.

Kehr, A. E., O'brien, M. J., & Davis, E. W. (1962). Pathogenicity of *Fusarium oxysporum f. sp. cepae* and its interaction with *Pyrenochaeta terrestris* on onion. *Euphytica*, **11**(2), 197-208.

Lacy, M. L., & Roberts, D. L. (1982). Yields of onion cultivars in midwestern organic soils infested with *Fusarium oxysporum f. sp. cepae* and *Pyrenochaeta terrestris* **7**(2), 1003-1006.

Malathi, S., & Mohan, S. (2023). Pathogenicity and Morphological Variabilities of *Fusarium oxysporum f. sp. cepae* Isolates in Onion. *Madras Agricultural Journal*, **99** (jul-sep), 1.

Mandal, M., Rana, D. and Misra, D.K. (2018). Studies on cultural characteristics of Fusarium isolates causing panama wilt of banana under West Bengal. *Journal of Pharmacognosy and Phytochemistry*, **7**(3), 833-840.

Mhammad A., Shahid H., Muhammad R., Rahila R., Mehreen H. and Shabbir H. (2019). Biological control and pathogenicity of the *Fusarium oxysporum* caused onion wilt in different localities of sindh and baltistan region. *International Journal of Biotechnology and Microbiology*, **1**(1), 26-31.

Mishra, R. K., Jaiswal, R. K., Kumar, D., Saabale, P. R., & Singh, A. (2014). Management of major diseases and insect pests of onion and garlic: A comprehensive review.

Journal of Plant Breeding and Crop Science, **6**(11), 160-170.

Mudiyanselage, Mahalaksha, Chandrika, Dissanayak, Rumi, Kashima, Shuhei, Tanaka and Shin-ichi Ito. (2009). Pathogenic variation and molecular characterization of *Fusarium* species isolated from wilted welsh onion in Japan. *Journal of General Plant Pathology*, **75**(1), 37-45.

Muthukumar G., Udhayakumar R., Muthukumar A., Muthukumaran N. and Ayyandurai M. (2022). Survey on disease incidence of basal rot of onion incited by *Fusarium oxysporum f. sp. cepae* in major onion growing tracts of Tamil Nadu. *The Pharma Innovation Journal*, **11**(8), 1445-1454.

Muthukumar, G., Udhayakumar, R., Muthukumar, A., Muthukumaran, N., & Ayyandurai, M. (2022). Survey on disease incidence of basal rot of onion incited by *Fusarium oxysporum f. sp. cepae* in major onion growing tracts of Tamil Nadu. *J. Pharmacognosy and phytochemistry*, **11**, 1445-1454.

Nath, N., Ahmed, A.U., Aminuzzaman, F.M. (2017). Morphological and physiological variation of *Fusarium oxysporum f. sp. ciceri* isolates causing wilt disease in chickpea. *International Journal of Environment, Agriculture and Biotechnology*, **2**(1), 2456–1878.

National Horticultural Research and Development Foundation (NHRDF). Nashik; 2025.

Nelson, P. E. (1983). *Fusarium species.* An illustrated manual for identification.

Rajendran, M., Sankarasubramanian, H., Gandhi, K. and Thiruvengadam, R. (2018). Comparative Proteomic Analysis of Different Isolates of *Fusarium oxysporum f. sp. lycopersici* to Exploit the Differentially Expressed Proteins Responsible for Virulence on Tomato Plants. *Frontiers in Microbiology*, **9**(2), 420-426.

Ramachandran, L., Raju, K., Venkatesan, S. A., Devarajan, D., & Senniyappan, M. (2026). Survey and characterisation of *Fusarium oxysporum f. sp. cepae* causing basal rot of onion *(Allium cepa L.)* in Perambalur district of Tamil Nadu. *International Journal of Research in Agronomy*; **9**(1): 625-630.

Salam, A.M., Hussain, S. and Abro M.A. (2015). Evaluation of different botanical extracts on the linear colony growth of the fungus Fusarium wilt of mango nursery and its *in-vitro* control. *European Journal of Biotechnology and Bioscience*, **3**(11), 7-14.

Saxena, A. (2007). Screening of Onion Cultivars for *Fusarium* Basal Rot and Spatial Distribution (Doctoral dissertation, New Mexico State University).

Shamyuktha J, Sheela J, Rajinimala N, Jeberlinprabina B, Ravichandran C. (2020). Survey on onion basal rot disease incidence and evaluation of aggregatum onion genotypes *against Fusarium oxysporum f. sp. cepae. International Journal of Current Microbiology and Applied Sciences*, **9**(7), 529–536.

Shamyuktha. J., Sheela J., Rajinimala N., Jeberlinprabina B. and Ravindran. C. (2020). Survey on Onion Basal Rot Disease Incidence and Evaluation of Aggregatum Onion *(Allium cepa L. var. Aggregatum Don.)* Genotypes Against *Fusarium oxysporum f. sp. cepae. International Journal of Current Microbiology and Applied Science*, **9**(07), 529-536.

Shin, J. H., Lee, H. K., Back, C. G., Kang, S. H., Han, J. W., Lee, S. C., & Han, Y. K. (2023). Identification of *Fusarium* basal rot pathogens of onion and evaluation of fungicides against the pathogens. *Mycobiology*, **51**(4), 264-272.

Singh, R., Laxmikant and Singh, M. (2016). Management of root rot of pea *(Pisum sativum L.)* through commercially available bioagent formulation and fungicide. 6th International Conference Plant, Pathogens and People, New Delhi, India. **7**(3), 103-109.

Tirado-Ramírez, M. A., López-Orona, C. A., Díaz-Valdés, T., Velarde-Félix, S., Martínez-Campos, A. R., Romero-Gómez, S. J., & Retes-Manjarrez, J. E. (2019). First report of basal rot of onion caused by *Fusarium brachygibbosum* in Sinaloa, Mexico. *Plant Disease*, **103**(3), 582.

Vetrova, S., Alyokhina, K., Engalycheva, I., Kozar, E., Mukhina, K., Sletova, M & Martynov, V. (2024). Identification and pathogenicity of *Fusarium* species associated with onion basal rot in the Moscow Region of Russian Federation. *Journal of Fungi*, **10**(5), 331.

Vignesh, K., Rajamohan, K., Balabaskar, P., Anandan, R. and Udhayakumar, R. (2021). Survey on the incidence of Fusarium wilt of tomato incited by *Fusarium oxysporum f. sp. lycopersici* (Fol) in major tomato growing areas of krishnagiri district. *Plant Archives*, **21** , 2369-2376.

Vijayrao, T. S. (2024). *Studies on Basal Rot of Onion (Allium cepa L.)* (Doctoral dissertation, Mahatma Phule Krishi Vidyapeeth).

Villevieille, M. (1996). Improvement of a screening test for *Fusarium oxysporum* f. sp. *cepae. Synder and Hansen Acta Botanica Gallica*, **143**, 109 115.

Yadav, G.M.B and Mishra, J.P. (2020). In vitro study of onion basal rot caused by *Fusarium Oxyporum. Journal of Emerging Technologies and Innovative Research*, **7**(5), 357-366