RESEARCH ARTICLE

Survey on the Disease Incidence of *Alternaria* Blight of Mustard in Eastern and Central Parts of Uttar Pradesh

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DOI: 10.18811/ijpen.v10i01.09

Abstract

A survey was conducted to assess the prevalence and Incidence of *Alternaria* blight in rape seed mustard during the *Rabi* seasons of 2021–2022 and 2022–2023. The survey was conducted in seven Eastern and central Uttar Pradesh districts, namely Ayodhya, Barabanki, Gonda, Jaunpur, Kanpur, Lucknow, and Varanasi. The five villages were selected randomly in each district. The district Lucknow has recorded the highest average Percent Disease Incidence (58.95%) followed by Kanpur (54.56%) and Varanasi (58.89%). The minimum Percent Disease Incidence was recorded in Ayodhya (40.23%) in the year 2021–22. In the year 2022–23 The Kanpur district recorded the maximum percent disease incidence (58.82%) followed by Lucknow (57.23%), and Jaunpur (53.00%). The minimum percent disease incidence was recorded at Ayodhya district (46.69).

Keywords: *Alternaria*, Survey, Disease incidence, Prevalence, PDI.

Highlights

- Assessed the incidence of Alternaria blight in mustard crops across Eastern and Central Uttar Pradesh.
- Implemented systematic sampling techniques to ensure representative data collection.
- Gathered information on disease occurrence through field surveys and visual inspections.
- Extended survey efforts across diverse locations to capture variations in disease incidence.
- Collaborated with local farmers and agricultural experts to enhance survey effectiveness.

International Journal of Plant and Environment (2024); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

Brassica juncea (L.) Czern. & Coss, commonly known as Indian mustard, holds significant importance as an oilseed crop within the *Brassica* group. It is characterized as a natural amphidiploid with a genome size of 920 Mb (Thakur *et al.,* 2020; Bhaghel *et al.,* 2020). Indian mustard exhibits cross-pollination tendencies and possesses a genome consisting of two sets of chromosomes (2n = 36, AABB genome). The plant is cultivated worldwide for its oil, condiment, and leafy vegetable properties in many regions around the globe (Shyam *et al.,* 2021).

B. juncea, often known as Indian- mustard, holds paramount importance as a cultivated species in India. It encompasses a substantial portion, around 90%, of the total cultivated area (88.58 million hectares) and production (128.18 Million tonnes) of mustard crops. Notably, its productivity reached 1447 kg per hectare during the agricultural year of 2022-23, as reported by the Ministry of Agriculture and Farmers Welfare, Government of India 2023 (Anonymous 2023).

The mustard crop suffers from many fungal viral and bacterial diseases. The fungal disease *Alternaria* leaf spot, caused by the fungi *A. brassicae* and *A. brassicola*, is a highly prevalent and damaging disease that affects indian-mustard crops. It leads to significant reductions in both yield (15–71%) and oil content (14.6–36%) (Bal and Kumar, 2014; Wang *et al.,* 2021).

Material And Methods

A comprehensive survey was conducted to assess the prevalence and intensity of *Alternaria* blight in Indian mustard (*B. juncea)* during the agricultural *Rabi* seasons of 2021–2022 and 2022–2023. Data collection for this study will primarily be conducted in farmer's fields, allowing for observations to be recorded under natural conditions. A survey was undertaken to document the prevalence and spatial distribution of *Alternaria* blight, a fungal disease affecting Indian mustard, in the Central and Eastern regions of Uttar Pradesh, India. The study encompassed five villages and selected five fields from each district and village, focusing on the major mustard cultivation areas. The districts included Ayodhya, Barabanki, Gonda, Jaunpur, Kanpur, Lucknow, and Varanasi.

The villages within each district were selected using a random sampling method. In this study, the number of fields visited per village was observed to range from 5 to 10. These fields were located at an average distance of 15 to 20 km from each village. The survey encompassed the collection of data

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How to cite this article: Pandey, M. K., Ahmad, M. M., Siddiqui, S., Kumar, A., Singh, S. K. and Rai, D. (2024). Survey on the Disease Incidence of *Alternaria* Blight of Mustard in Eastern and Central Parts of Uttar Pradesh. International Journal of Plant and Environment. 10(1), 69-75.

Submitted: 10/01/2024 **Accepted:** 16/02/2024 **Published:** 30/03/2024

Table 1: Cropping information (District, Village, Soil type, Agronomic practices, Sowing time)

S. No.	*District*	*Village*	*Variety*	*Soil type*	*Agronomic practices*	*Sowing time*
		Baisingh	RLM 1724, RLM 198	Silt loam	After harrowing sowing behind country plough	Mid oct to last week of Dec
		Saithu	Pineer 45S46, CS-60	Silt loam	Two time ploughing by cultivator and sowing with rotavator	Mid oct to last week of Dec
1	Ayodhya	Purepahalwan	Royal Saffron, Sabera 707	Sandy loam	Two time Harrowing and sowing with cultivator	Mid oct to last week of Dec
		Sanairashi	Bayer 5222, HDB 414	Sandy loam	After harrowing sowing behind country plough	Mid oct to last week of Dec
		Darshan Nagar	HDB 414, Bayer 5222	Silt loam	Two time ploughing by cultivator and sowing with rotavator	Mid oct to last week of Dec
		Gokulpur	Varuna, Maya, Urvashi,	Clay soil	After harrowing sowing behind country plough	2nd week of Oct to Nov last week
		Harkh	N.D.R. 8501,RLM 198	Clay soil	Two time harrowing with disk harrow and sowing with cultivator	2nd week of Oct to Nov last week
2	Barabanki	Satrickh	Sabera 707, Maya	Sandy soil	Two time harrowing with disk harrow and sowing with cultivator	2nd week of Oct to Nov last week
		Barole	Vardan,	Sandy soil	Two time ploughing rotavetor and sowing with cultivator	2nd week of Oct to Nov last week
		Jermapur	Sabera 707	Sandy soil	Two time harrowing with dick harrow and sowing with cultivator	2nd week of Oct to Nov last week
		Chhatauni	Crystal-5222, 5210,	Silty clay loamy soil	Two time ploughing rotavetor and sowing with cultivator	Mid Oct to last week of Dec
		Dehras	C S-52, C S-58	Loamy soil	Two time ploughing rotavetor and sowing with cultivator	Mid Oct to last week of Dec
3	Gonda	Mohna	Champion, 5210	Sandy loam soil	Two time ploughing rotavetor and sowing with cultivator	Mid Oct to last week of Dec
		Paraspur	Pioneer 45s46,Varuna,	silty clay loamy soil	Two time harrowing with dick harrow and sowing with cultivator	Mid Oct to last week of Dec
		Udhaura	Varuna, 5222	Sandy soil	Two time ploughing rotavetor and sowing with cultivator	Mid Oct to last week of Dec
		Kushaha	Hybage 7044, Sabera 707, RLM 198	Sandy loam	Two time Ploughing by cultivator and sowing with rotavator	Mid Oct. to first week of Nov.
		Budhanepur	Sabera 707, Hybage 7044	Sandy loam	Two time Ploughing with rotavator and sowing with cultivator	Mid oct. to first week of Nov.
4	Jauanpur	jokhapur	Pineer 45S46, Sabera 707	Sandy loam	Two time Harrowing and sowing with cultivator	Mid oct. to first week of Nov.
		Gajendrapur	RLM 198, Pineer 45S46	Sandy loam	Two time Ploughing with rotavator and sowing with cultivator	Mid oct. to first week of Nov.
		Rooppur	Sabera 707, Hybage 7044, CS-60	Sandy loam	Two time Ploughing by cultivator and sowing with rotavator	Mid oct. to first week of Nov.
		Lodhar	5111, 5222, 45s46, Rai kuria,	Sandy soil	Two time harrowing and sowing with cultivator	Last week of Sep to Nov 2ndteek
		Nakatoo	Albeli-1, EJ 17	Sandy soil	Two time harrowing with cultivator and sowing with cultivator	Last week of Sep to Nov 2ndteek
5	Kanpur	Kursauli	NPJ 124 , 45s46	Sandy soil	Two time harrowing with cultivator and sowing with cultivator	Last week of Sep to Nov 2ndteek
		Pakari	Azad mahek, CS 58	Sandy soil	Two time harrowing with cultivator and sowing with cultivator	Last week of Sep to Nov 2ndteek
		Patarsa	5111, 5222, 45s46,	Sandy soil	Two time harrowing with cultivator and sowing with cultivator	Last week of Sep to Nov 2ndteek

		Atharkhera	Rohini, 45s35, kaliya,	Silty loam	Two time harrowing with rotavetor and sowing with cultivator	1st week of Oct to Nov last week
		Akbarpur	NPJ 113, EJ 17,	Silty loam	Two time harrowing with rotavetor and sowing with cultivator	1st week of Oct to Nov last week
6	Lucknow	Arjunpur	PM 30 (LET 43)	Silty loam	Two time harrowing with rotavetor and sowing with cultivator	1st week of Oct to Nov last week
		Bahadurjung	RGN 298, CS-60	silty clay loam	Two time harrowing withdisk harrow and sowing with cultivator	1st week of Oct to Nov last week
		Pehta	Azad mahek, CS-58	silty clay loam	Two time harrowing withdisk harrow and sowing with cultivator	1st week of Oct to Nov last week
		Ramraypur	Shreeram 1666, CS-60, RLM 198	Sandy	Two time Ploughing by cultivator and sowing with rotavator	Last week Oct. to 3rd week Nov.
		Satttanpur	Sabera 707, PAC 737, RLM 1724	Sandy loam	Two time Ploughing with Rotavator and sowing with cultivator	Last week Oct. to 3rd week Nov
7	Varanasi	Dharsauna	PAC 737, Sabera 707, RLM 198	Silt loam	Two time Harrowing and sowing with cultivator	Last week Oct. to 3rd week Nov
		Bhisampur	Shreeram 1666, CS-60, RLM 198	Sandy loam	Two time Ploughing with Rotavator and sowing with cultivator	Last week Oct. to 3rd week Nov
		Dunyapur	PAC 737, Sabera 707, Shreeram 1666	Silt loam	Two time Harrowing and sowing with cultivator	Last week Oct. to 3rd week Nov

Table 2: Prevalence of blight disease of mustard in central and eastern UP-2021-22 & 2022-23

S. No.	*District name*	*Villege Surveyed*	*PDI of Alternaria blight 2021-22 (%)*	*Avg. PDI of Alternaria light 2021-22 (%)*	*PDI of Alternaria blight 2022-23 (%)*	*Avg. PDI of Alternaria blight 2022-23 (%)*
1		Baisingh	38.33		40.73	
		Saithu	41.32		35.82	
	Ayodhya	Purepahalwan	39.38		50.91	
		Sanairashi	44.21		56.46	
		Darshan Nagar	37.91	40.23	49.55	46.69
2		Atharkhera	47.01		60.95	
		Akbarpur	43.55		49.4	
	Barabanki	Arjunpur	49.72		45.34	
		Bahadurjung	44.92		49.62	
		Pehta	51.37	47.31	41.31	49.32
3		Lodhar	43.94		45.76	
		Nakatoo	52.73		54.23	
	Gonda	Kursauli	41.53		48.54	
		Pakari	56.58		59.62	
		Patarsa	44.61	47.87	42.54	50.13
4		Kushaha	47.2		50.89	
		Budhanepur	48.32		45.67	
	Jaunpur	Jokhapur	41.89		60.92	
		Gajendrapur	47		55.18	
		Rooppur	42.41	45.36	52.34	53.00
5		Chhatauni	48.93		62.19	
		Dehras	60.31		56.28	
	Kanpur	Mohna	55.53		45.37	
		Paraspur	51.37		72.64	
		Udhaura	56.67	54.56	57.65	58.82

6		Gokulpur	56.58		73.51	
		Harkh	59.55		61.82	
	Lucknow	Satrickh	63.25		48.73	
		Barole	53.73		52.32	
		Jermapur	61.66	58.95	49.8	57.23
7	Varanasi	Ramraypur	48.55	51.89	50.24	49.77
		Satttanpur	55.46		48.39	
		Dharsauna	49.62		54.51	
		Bhisampur	53.37		55.55	
		Dunyapur	52.46		40.2	

pertaining to various aspects, including soil type, cultivars grown and disease incidence, and agronomic practices, as shown in Table 1. This information was meticulously recorded for further analysis and evaluation. This study employed a systematic sampling method to select one square meter quadrant at random within each field. This sampling approach aimed to ensure an unbiased representation of the entire field area. Subsequently, the number of infected plants present within each selected quadrant was meticulously counted. This method allowed for accurate quantification of the extent of plant infection within the respective fields. To determine the disease incidence, the number of infected plants and the total number of plants were taken into consideration. The incidence of this disease was observed, monitored, and documented. The formula measured the percentage disease intensity (PDI)

PDI = [Total number of infected plant/Total no. of plants] x 100

According to the data collected by the meteorological station, we have noticed minimal changes in the average temperature during the *Rabi* season of 2021-22 and 2022-23, as depicted in Figs 1 and 2.

Humidity levels may significantly influence the potential dissemination of the *Alternaria* disease. The following figures, Figs 3 and 4, present the methodological data. The present study has revealed the existence of significant fluctuations in the percentage of humidity within the field.

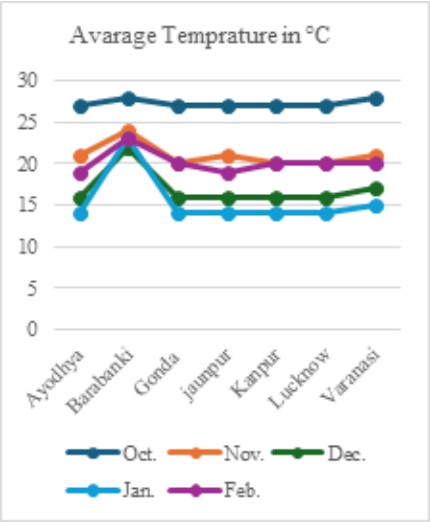

Fig. 1: Average Temperature in 2021-22

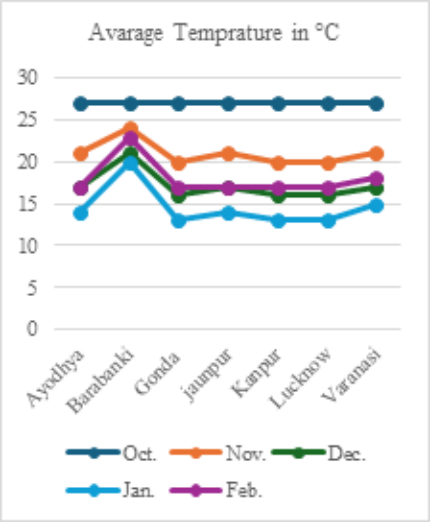

Fig. 2: Average Temperature in 2022-23

Results And Discussion

Farmer Practices

According to the findings presented in Table 1, it can be deduced that farmers primarily opt for hybrid varieties because of various factors, including but not limited to the selection of suitable varieties, consideration of soil type, implementation of appropriate agronomic practices, and strategic timing of sowing. The present study conducted a comprehensive survey of the field across seven districts in Eastern and Central Uttar Pradesh, aiming to investigate the variations in soil types within the region. The present study investigates the distribution of sandy soil in various regions of Uttar Pradesh, specifically Kanpur, Jaunpur, Ayodhya, Barabanki, and Gonda. The primary objective is to determine the prevalence and extent of sandy soil in these areas. By examining the soil composition and characteristics, this research aims to contribute to the existing knowledge on soil types and their geographic distribution in Uttar Pradesh. The present study aimed to investigate the occurrence of sandy loamy soil in various Ayodhya, Jaunpur, Gonda, and Varanasi regions. The researchers conducted field observations

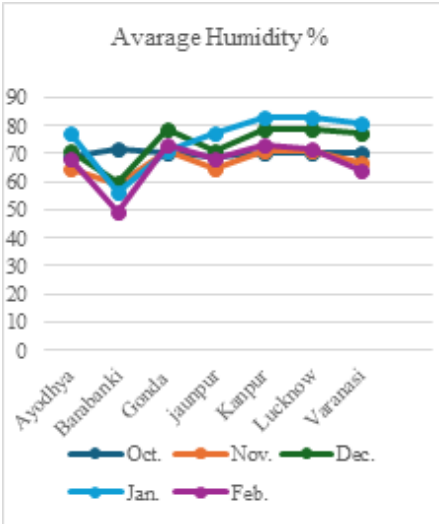

Fig. 3: Average Humidity % in 2021-22

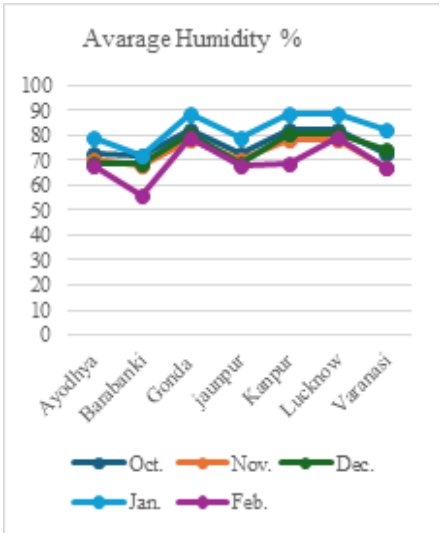

Fig. 4: Average Humidity % in 2022-23

to identify and document the presence of this soil type in the aforementioned areas. The findings revealed the widespread occurrence of sandy loamy soil, indicating its significance in the local soil composition. This research contributes to the existing knowledge on soil types in these regions and provides valuable in the presence of silty loamy and silty clay loam soils that have been observed in Ayodhya, Gonda, as well as specific regions of Lucknow, and Varanasi. Field preparation is a crucial step in agricultural practices, as it sets the foundation for successful crop growth and development. Farmers commonly utilise various mechanised tools such as the rotavator, disc harrow, and cultivator to achieve optimal field conditions. These implements play a significant role in preparing the soil for planting and ensuring favorable conditions for seed germination and plant establishment. The rotavator, a widely employed tool in farming, is designed to break in the agricultural region of Aayodhya, Gonda. It has been observed that the local farmers engage in the practice of sowing their crops during a specific timeframe. This

Fig. 5: Alternaria affected mustard leaf

timeframe spans from the middle of October and extends until the final week of December. According to research conducted in Kanpur, the optimal sowing period for agricultural activities spans from the final week of September to the second week of November. This timeframe has been identified as the most suitable for initiating the process of planting crops in the region. According to research findings, the sowing period in Barabanki, a region of Uttar Pradesh, India, typically commences during the second week of October and extends until the first week of November. This timeframe is considered optimal for initiating the process of planting crops in the region. According to the available data, the festival season in Lucknow commences in the initial week of October and extends until the final week of November. Similarly, in Varanasi, the festival season begins in the concluding week of October and concludes in the third week of November.

PDI

The percent disease incidence of *Alternaria* blight disease in Indian mustard demonstrates substantial variability throughout the seven prominent districts situated in central and eastern Uttar Pradesh. The observed disease incidence within the surveyed districts exhibited a range of 40.23 to 58.95% during the consecutive years of 2021–2022 and 2022–2023, presented in Table 2 thereby suggesting a persistent and uniform trend of prevalence. The manifestation of the disease has been observed across seven districts in the eastern and central regions of Uttar Pradesh as shown in Figs 5 and 6. However, it is noteworthy to mention that the disease's highest incidence during the period of

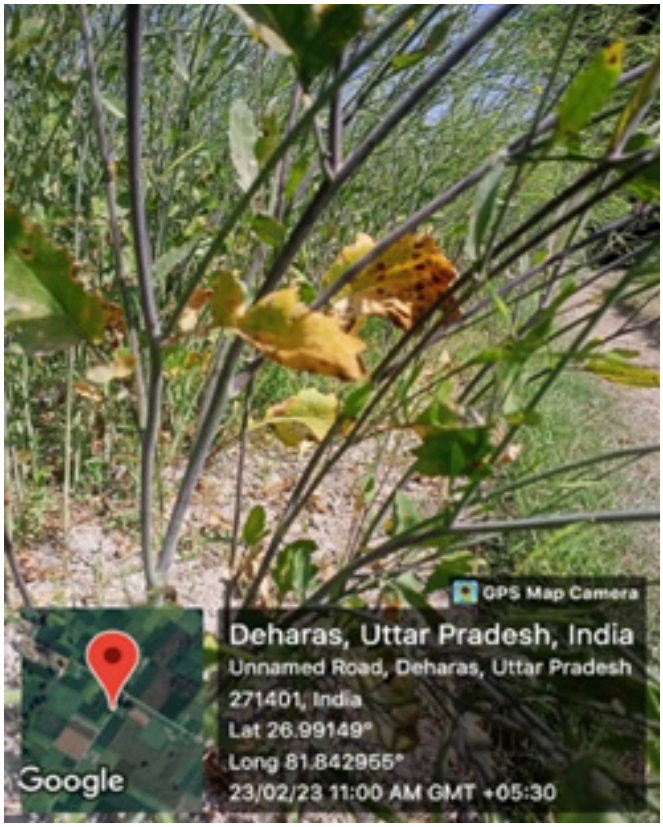

Fig. 6: Alternaria affected mustard plant

2021–2022 was documented in Lucknow, exhibiting a substantial prevalence rate of 58.95%. The urban centers exhibiting the most elevated scores in Uttar Pradesh, India, are delineated as follows: In the present study, Kanpur exhibited the highest score of 54.56%, thereby establishing its prominence in the observed parameters. Following closely, Varanasi demonstrated a score of 51.89%, indicating its proximity to Kanpur in terms of the evaluated factors. In the present study, Gonda municipality exhibited a commendable performance by attaining the third position with a notable score of 47.87%. Similarly, Barabanki demonstrated a commendable performance by securing the fourth position with a score of 47.31%. In the present study, the municipality of Jaunpur exhibits a proximate position with a score of 45.36%, indicating a notable susceptibility to certain plant pathology factors. Similarly, Ayodhya concludes the list, displaying a score of 40.23%, suggesting a relatively lower vulnerability to the aforementioned plant pathology factors. During the period spanning from 2022 to 2023, an extensive investigation was conducted to assess the disease incidence in Kanpur, a region of interest. The findings revealed a remarkable prevalence rate of 58.82%, indicating a substantial burden of disease within the studied population. The present study investigated the incidence of plant pathology in various regions. The results revealed that Lucknow exhibited a notable incidence rate of 57.23%. Following Lucknow, Jaunpur displayed a substantial incidence rate of 53.0%, while Gonda exhibited an incidence rate of 50.13%. Moreover, Varanasi demonstrated a relatively high incidence rate of 49.77%, whereas Barabanki and Ayodhya exhibited incidence rates of 49.3 and 46.92%, respectively. These findings provide valuable insights into the distribution of plant pathology.

The presented statistics underscore the concerning proliferation of diseases within the regions throughout the specified timeframe. Various studies conducted in past as follows: In a study conducted by Mamta *et al.,* 2016, it was found that the disease intensity was highest at 53.60% in Kalyanpur (Kanpur), while the lowest intensity of 37.60% was recorded in Bagha (Kanpur). Patel and Singh 2021, also found similar results in their survey 2019-20. In a comprehensive study conducted by Gupta *et al.,* 2017, it was discovered that the highest disease intensity of 44.13% was observed in Chatha, while the lowest disease intensity of 28.90% was recorded in the Gudwal area of Jammu Province. In a study conducted by Chadar *et al.,* 2016, A significant disease intensity of leaf blight of mustard, ranging from 23.9 to 62.0%, was observed in the Jhansi region of India. *Alternaria* blight has been reported in all states of India, with varying severity and incidence (Saharan *et al.,* 2005). According to a study conducted in Australia, *Alternaria* spp. have been found to cause significant field yield losses of over 58% on oilseed rape (Al-Lami *et al.,* 2019).

Conclusion

The prevalence rate in Lucknow stands at a significant 58.95%. Presenting an overview of the urban centers that have achieved remarkable scores in Uttar Pradesh, India: According to the study, Kanpur achieved the highest score of 54.56% in the year 2021-22. The results showed a significant prevalence rate of 58.82% in Lucknow and 57.23% varanasi. The percentage in Jaunpur is 53.00%. In the upcoming year of 2022–23. We observe a minimal shift in the prevalence rate due to the adoption of comparable farming practices.

Acknowledgements

I am truly thankful to Integral University for granting me the invaluable chance to participate in research, offering their unwavering support, and providing the manuscript communication number (MCN) IU/R&D/2024-MCN0002428. Thankful for the support and cooperation from research stations and departments in providing meteorological data.

Authors Contribution

M. P. Planning of study, review and editing of MS. M.M.A. Conceptualization of idea & supervision of the study. S.S. Head of Department and Review editing of MS and correction as per suggestion from reviewer and editor. A.K. correction as per suggestion from reviewer and editor. S.K.S. and D.R. conceptualization of idea and writing original draft of Manuscript and collection of review literature and compilation.

Conflict of interest

The authors have no conflict of interest.

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