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Effect of sowing dates on severity of the pathogen Myrothecium leaf spot of sesame (*Sesamum indicum* L.)

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Abstract
In India, Seasame (*Sesamum indicum* L.) among the several oil crops has its own importance due to its oil content, flavour, and medicinal and ritual values. Sesame belongs to the family Pedaliaceae and is known in vernacular as 'Til'. The Myrothecium leaf spot caused by *Myrothecium roridum* Tode ex fr. is one of the most important fungal disease of sesame. This disease was found to be prevalent in all over area surveyed showing its wide spread occurrence during this study. The 5 point scale method was used to check severity of disease after pathogenicity test followed by the isolation, purification and sowing activities. Minimum disease incidence was found when crop was sown early in the season whereas maximum disease severity was observed when the crop was sown late in the season. It, therefore, can be said that the sowing of crop sesame early or in last week of June and first week of July affected less by the disease Myrothecium.

Keywords: sesame, severity, disease, Myrothecium, sowing date, etc

Introduction
Sesame (*Sesamum indicum* L.) is an important oil crop in India and other parts of the world [1, 12]. It belongs to family Pedaliaceae, and is known in vernacular as 'Til'. The word 'Sesamum' was used by Latin author Watt [17] as 'Gingelli'. It has also mentioned in Sanskrit language as ‘Tile’. The place of origin of sesame is controversial as De. Candole [3] reported its ancient cultivation is in the Euphast Valley but Watt [17] suggested its probable centre of origin in the region between 'Euphastis Valley, Bokhar South of Afghanistan and upper India. Sesame (*Sesamum indicum* L.) is grown extensively in India, China, Mexico, Sudan, Venezuela, Nigeria, Columbia, Uganda, Pakistan, Burma. In India, sesamum indicum, which the cultivated type, drought tolerance and can be grown where other crops fail, is originated. Nine varieties of sesame seeds are currently produced in India. Gujrat is leading sesame producing state contributing 22.3% of total production followed by West Bengal (19.2%), Karnataka (213.5%), Rajasthan (9.8%), Madhya Pradesh (9.06%), Tamilnadu (4.7%), Andhra Pradesh (4.52%) and Maharashtra (4.52%). Since, the sesame seed oil is a common ingredient in cuisines across the world, its production is increasing with its demand. In India, the harvest yield of sesame seeds was estimated at around 178000 MT during 2018 which was short by 60% to meet the demand as against 418000 MT in 2017. The production of sesamum seed was lagged due to poor climate conditions and consequently pathogenic attack.

Sesame seeds are very good source of copper, magnesium and calcium. It’s seeds are rich in oil (50-52%), protein (17-19%) and carbohydrate (16-18%). According to Hindu mythology and beliefs, sesame seeds and oil are considered as symbol of immortality and most auspicious. Sesame flour has high protein, high levels of methionine and tryptophan, essential amino acids. Because of the high unsaturated fat and methionine contents [5, 16] sesame seed and oil has high demand as export materials. Sesame seeds are used in large number of confectionary products and sweets in addition to industrial, nutraceutical and pharmaceutical uses. Sesame oil is considered to be one of the healthiest cooking oil due to rich source of oleic (40-50%) and linoleic (35-45%) fatty acids.

The sesame oil contains 14 per cent saturated fatty acids (8 per cent palmitic acid and 4 per cent stearic acid), 80 per cent unsaturated fatty acids, 2 per cent unsaponifiable matter and iodine value 114. Sesame oil cake is rich in proteins and is used as a cattle feed. It can also be used as an organic manure to increase soil fertility. In India, sesame oil is used as a hair oil in combination with one or other scented oils. The oil and plant both are used for medicinal purpose. Sesame oil have fungicidal properties against the fungus like *Sphaerotheca humuli*, *Odium spp*. and *Hemileia vastatrix* Martin and Salman [7] and Narasimah [8].

Sesame, thus, has attracted the attention of plant pathologists all over the world due to number of disease of various origins that affected its production and quality.

The sesame crop is reported to be affected by several important diseases caused by fungi, viz., *Phytophthora sesami*, *Corynespora sesami*, *Alternaria sesami*, *Cersospora sesami Rizoctonia batalicola*, *Oidium sp.* and *Myrothecium roridum* and two bacterial diseases namely, bacterial blight (*Xanthomonas sesami*) and bacterial leaf spot (*Pseudomonas sesami*). Among the disease leaf spot caused by *Myrothecium* species is one of the most important disease causing considerable losses in India. The disease was first reported from Uttar Pradesh by Singh and Srivastava [13]. The pathogen not only reduces the production of sesame but also hampered the oil quality. The disease affects all the aerial parts of the plant but is more severe on leaves where small, circular to irregular, tan coloured spots with brown margins, measuring up to 15 mm in diameter appear. The older spots become papery with several brown concentric rings, under humid conditions, the lower surface of the leaf spots is profusely inundated with numerous spordochia, generally arranged in concentric rings. Severely infected leaves often dry up and shed prematurely. More often, the necrotic tissues of the spots shred away leaving a shot hole in the centre.

Keeping in view the seriousness of the disease and importance of the crop, it was thought necessary to work out the detailed account of symptomatology, etiology, perpetuation and management of the disease to be made to boost up production of the important oilseed crop to keep place of increasing population, the present study was undertaken with the following objectives:-

Material and Methods

Experiments were carried out to estimate the disease incidence in different growing periods of sesame during the two successive crop season, first year and second year of study. A susceptible variety of sesame "Type-4" was sown in the field on different sowing dates such as (first year: 28 June, 5 July, 12 July, 19 July and 26 July; second year: 28 June, 4 July, 12 July, 19 July and 26 July) in three replications. The data regarding disease intensity were recorded at different dates of crops sown starting from the first appearance of the disease and subsequently to fort nightly intervals till the maximum disease intensity occurred. Percent disease of plant was assessed by calculating the disease index by using following formula:

$$\text{Present disease index} = \frac{\text{Sum of all numerical rating}}{\text{Total number of leavers examined}} \times \frac{100}{\text{Maximum disease category}} \quad (1)$$

The 5 point scale was used for recording of the datum to check the disease intensity (Table 1).

Table 1: The 5 point scale for disease intensity

Numerical rating	Description
0	No symptoms
1	Less than 10 per cent of the leaf area affected
2	10-40 per cent of the leaf area affected
3	41-75 per cent of the leaf area affected
4.	More than 75 per cent of the leaf area affected

$$\text{Disease intensity} = \frac{\text{Sum of all numerical rating}}{\text{Total number of plants examined}} \times \frac{100}{4} \quad (2)$$

Isolation and purification

Selected diseased leaves of sesame were thoroughly washed with sterilized distilled water in order to remove the surface contamination. Portion of the diseased leaves, just touching the healthy parts, were cut into small pieces by a sterilized scalpel. The surface sterilization of separated portion of diseased leaves were done by dipping them into the 0.1 per cent mercuric chloride solution for 15-20 seconds and then thoroughly washed (3-4 times) using sterilized water to remove the traces of mercuric chloride. Finally the excess water was removed by blotting paper. The pieces were then transferred in 2 per cent potato dextrose agar in 90 mm Petri plates. Three such pieces were placed at an equal distance in each Petri dish with the help of sterilized forceps aseptically. The inoculated petridishes were incubated at room temperature (22-27 ^{o}C). The petridishes used for isolation were already sterilized in hot air oven at 160 ^{o}C for two hours and poured with 2 per cent potato dextrose agar medium. Potato dextrose agar medium was also sterilized before use in an autoclave at the pressure 1.1 kg/cm^2 for 20 minutes.

As soon as the mycelial growth was found to be visible around the pieces, fungal tips from the growing mycelium were transferred to culture tube containing 2 per cent potato dextrose agar medium.

Isolated fungus was purified by the single spore technique described by Keitt [6] and Ezekiel [4] and modified by Neergaard [10]. Bacterial contamination of the pure culture was removed by employing the method given by Brown [2], where ever felt necessary. The single spore cultures from different collections were maintained and stored on 2 per cent PDA slants at 5-10 °C in refrigerator for further studies. To keep the fungus in viable and active stage, sub-culturing was done fortnightly.

Pathogenicity test

Pathogenicity of the isolated fungus was done on one month old plants, raised in 30 cm earthen pots under glass house, and were inoculated by spraying spore and mycelial suspension. Spore and hyphal masses were also placed on some leaves already sprayed with sterilized water and covered with cotton wool. Both injured and uninjured leaves were used for inoculation. After inoculation, the plants were covered with polythene bags for 24 hours to provide maximum humidity and to prevent them from secondary infections. A set of un-inoculated plants was also maintained that received only sterilized water sprays. Plants were watered periodically to maintain requisite moisture for proper growth and development of the disease symptoms. The development of the disease symptoms was regularly observed and recorded. From these artificially produced leaf spots, re-isolations were made and the isolate obtained was compared with the original isolate to prove the Koch's postulates.

Results

Change in sowing date is cultural measure for crop disease management it reduces the period over which infection agents (Propagules) meet the susceptible stage of the host. If the environments favourable for the pathogen are the same as for the host, disease incidence is likely to be more. In the mean-time, it is also possible that the host can be grown at a much wider range of temperature and humidity, which may not be favourable for the pathogen. This dissimilarity in favourable environment for host and pathogen can be explained for disease management. One of the method to achieve this to alter the date of sowing so that the susceptible stage of plant growth does not coincide with the environment highly favourable for the pathogen. Early or delayed sowing of the crop enables the host to escape critical period. The results pertaining to the date of sowing and disease incidence recorded year wise are summarized in the Table-2.

The data presented in Table 2 and Fig.4, revealed that minimum disease severity was 25.21 per cent in first year and 29.30 per cent in second when crop was sown early in the season (28 June), whereas maximum disease severity 40.12 per cent and 44.45 per cent was observed when the crop was sown late in both the crop season (26th July). Thus, the finding showed the importance of sowing the crop when the best temperature and moisture condition present for rapid growth of the host to escape critical period of disease incidence.

Table 7: Effect of sowing dates on the severity of disease.

S. No.	Date of sowing	Plant disease severity in two successive Year	
		First	Second
1.	28 June	25.21	29.30
2.	5 July	27.32	31.62
3.	12 July	31.82	34.52
4.	19 July	36.42	39.31
5.	26 July	40.12	44.45
C.D. at 5% level of significant		4.30	4.90

Discussion

Change in sowing date is cultural measure for crop disease management. It reduces the period over which infection agents (Propagules) meet the susceptible stage of the host if the environment is favourable for the pathogen and is the same as for the host, disease incidence is likely to be more. In the meantime it is also possible that the host can be grown at a much wider range of temperature and humidity, which may not be favourable environment for host and pathogen can be explained for disease management. The result pertaining to the date of sowing and disease incidence was revealed that minimum disease severity was 25.21 per cent in beginning year and 29.30 per cent in the next year when crop was sown early in the season (28th June) whereas maximum disease severity 40.12 per cent and 44.45 per cent was observed when the crop was sown late in both the crop season (26th July). Similar observation has also been reported by the Sinha *et al.* [14]. They have reported that the early sowing of soybean susceptible variety (PK-262) reduced the incidence of disease caused by *Myrothecium roridum* in comparison to late sowing. Patra and Mishra [11] has also reported similar results. In their research they found that the date of sowing had significant ($p<0.05$) effect on capsules/plant higher capsules/plant which was recorded when the sesame crop was sown at 25 June. Narayan and Narayan [9], Solanki and Gupta [15], Patra and Mishra [11], etc. have also reported that date of sowing had significant effect ($p<0.05$) on sesame seed and oil yields. Thus, the finding showed the time of sowing of the crop, when the best temperature and moisture condition present, is very important for rapid growth of the host and to escape critical period of disease incidence. As the low temperature and short photoperiod of the post monsoon session caused for the under development/growth of branches, less number of seeds per capsule and test weight [9].

Conclusion

From the above studies it can be concluded that the change in sowing date is a cultural measure for crop disease management. It reduces the period over which infection agents (Propagules) meet the susceptible stage of the host. It was revealed that minimum disease severity was 25.21 per cent in first year and 29.30 per cent in the next year when crop was sown early in the season (28th June), whereas maximum disease severity was found to be 40.12 per cent and 44.45 per cent was observed when the crop was sown late in both season/ year (26th July). The main cause of disease severity was concluded as the short photoperiod and low temperature. This research, therefore, provide very basic fundamental research of disease causes factors for crops.

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