Acta Scientific AGRICULTURE (ISSN: 2581-365X)

Volume 8 Issue 2 January 2024

Research Article

Impact of Sowing Dates on Sesamum Phyllody Disease Caused by Phytoplasma

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DOI: 10.31080/ASAG.2024.08.1349

Received: December 15, 2023

Published: January 25, 2024

Abstract

Sesamum (*Sesamum indicum* L.) is one of the oldest oilseed crops and has been cultivated in ancient times. Among the major constraint the phyllody disease, caused by phytoplasma, is major for reducing yield as well as quality of sesamum. Sesamum phyllody is transmitted by leaf hopper, dodder and grafting from infected plant to healthy plant. Phyllody infected plant produced various symptoms such as flower converted into leaf like structure, floral virescence, sterility of flower, witches broom, shoot apex fasciations etc. To mitigate phyllody, this study delves into the impact of different sowing dates on sesamum cultivation during the Kharif season at the experimental farm of the Department of Plant Pathology, College of Agriculture, Latur by employs sesamum varieties JLT-408 and Prachi in a factorial randomized block design (FRBD). The investigation scrutinizes five distinct sowing dates (D1 to D5) to evaluate their effects on leaf hopper populations, disease incidence, and seed yield. The findings revealed that, the sowing of sesamum on 10th August exhibited the lowest leaf hopper population, recording a disease incidence of 6.64% and a yield of 810 kg/ha followed by 30th of July with disease incidence was 9.52% and yield 740 kg/ha. In contrast, the sowing on 20th July showed the highest leaf hopper population, with a disease incidence of 21.60% and a yield of 507 kg/ha. Additionally, among the varieties, JLT-408 displayed the maximum leaf hopper population (0.84 leaf hopper/leaf), coupled with a disease incidence of 16.58% and low yield of 430 kg/ha. Conversely, Prachi demonstrated the minimum leaf hopper population (0.52 leaf hopper/leaf), along with a disease incidence of 10.30% and more yield of 650 kg/ha. Present study highlighted that, late sowing of sesamum reduce outbreak of phyllody disease with minimum leaf hopper count and maximum yield.

Keywords: Sesamum Phyllody; Phytoplasma; Climate Change; Sowing Date Fluctuation; Leaf Hopper Population

Introduction

Sesamum (*Sesamum indicum* L.) stands as one of the earliest cultivated oilseed crops, with a rich history dating back to ancient times. Known by various names such as Til (Hindi), Ha ma (Chinese), Sesame (French), Goma (Japanese), Tal (Gujrati), Til (Punjab, Marathi), Nuvvula (Telgu), Ellu (Tamil), and Tila (Sanskrit) across different regions, it has earned the moniker "Queen of oil seeds" due to its high oil yield and quality [13]. Ancient Hindi sayings like "Til se dil" or "Til dil" underscore the cultural importance of sesamum for heart health. India holds the top position globally in both the area under cultivation and production of sesamum. A well-managed sesame crop is crucial for optimal yield. Major sesamum-producing states in India include Uttar Pradesh, Punjab, Jammu Kashmir, Assam, Maharashtra, Kerala, and Haryana. Particularly, in Maharashtra State, Marathwada region has been a consistent increase the cultivation of sesamum. The total area under sesamum cultivation in Maharashtra is approximately 312 ha, producing 46 tons, while in the Marathwada region, it is around 167 ha with a production of about 14 tons [3].

Phyllody of sesamum is a phytoplasma disease caused by microorganisms without cell wall, acting as obligate parasites found in plant sieve elements. First described as plant pathogens responsible for yellows disease [5], phytoplasma presence in phloem sieve tubes results in various yield losses in sesamum crops. Severe cases can lead to yield losses ranging from 34 percent to even 100 percent [12]. Studies have shown that a 1 per cent increase in disease incidence can reduce yield by 8.36 kg/ha [8]. Typical symptoms of sesamum phyllody include flowers transforming into leaf-like structures, floral virescence, floral proliferation, witches broom, shoot apex fasciations, stunted growth in infected plants, and the conversion of sepals and petals into leaf-like structures [2,10]. Transmission of sesamum phyllody occurs through insects, dodder, and grafting but no seed transmission [10]. Therefore, sesamum phyllody is not seed-borne in nature. Control measures involve vector control using systemic insecticides, and disease control by using tetracycline helps in reducing phyllody symptoms in infected plants [11]. In Marathwada region, Latur district is a hub of oilseed crop cultivation. In Latur district the sesame phyllody was major disease with causing economic loss of sesamum crop and its incidence was 22.60 per cent to 31.20 per cent was recorded [9]. Currently, farmers employ chemical control measures for managing sesamum phyllody disease. Numerous previous studies have focused on the chemical management of this disease. However, implementing chemical control measures is not always straightforward and may not be the most suitable approach. Therefore, adopting cultural practices emerges as one of the most effective and cost-efficient methods for disease management. Altering the sowing dates for disease management is one of commonly followed appropriate cultural practices in other crops. Given these considerations, this study investigates the impact of different sowing dates on phyllody disease to determine the most suitable cultivation date for sesamum in the kharif season.

Materials and Methods

The research was carried out during the Kharif season at the experimental farm of the Department of Plant Pathology, College of Agriculture, Latur. A field experiment was designed using a factorial randomized block design (FRBD) consisting of five treatments and three replications. Sesamum varieties JLT-408 (susceptible) and Prachi (resistant) were employed in this field experiment, with a spacing of 30 cm (row to row) and 15 cm (plant to plant). To facilitate optimal seedling germination, recommended fertilizer doses were applied along with light irrigation. Intercultural operations were conducted as needed. The specific treatments applied for the present investigation are outlined as follows.

Treatment No	Sowing date
D_1	25th June
D_2	10th July
D_3	20th July
D_4	30th July
D_5	10th August

Table a

Observation on leaf hoppers were recorded early in the morning on top, middle and bottom leaves of randomly selected plants. Leaf hopper count was recorded from 7 days after sowing with a weekly interval. Observations on phyllody were done from appearance of the disease and subsequent at 10-day interval up to the harvest of crop. Disease incidence was calculated by applying below formulae. Capsules were harvested and seed yield kg/ha was calculated.

$$\text{Per cent disease incidence (\%)} = \frac{\text{Number of phyllody infected plants}}{\text{Total number of plants observed}} \times 100$$

Statistical analysis

The data recorded in experiments were statistically analyzed in OPSTAT software by using FRBD design. The standard error (SE) and critical difference (CD) at 5% level of significance were worked out and results obtained were compared statistically.

Result and Discussion

Effect of different dates of sowing on leaf hopper population dynamics

Table 1 presents data illustrating the impact of various sowing dates on the leaf hopper populations. The findings highlight the significant influence of sowing dates on leaf hopper populations. A total of 12 counts of leaf hoppers were recorded. Recorded data from table 1 stated that, 35 days after sowing leaf hopper population was very less or negligible. Subsequently, there was an increase in leaf hopper population after 49 days of sowing, with the flowering stage identified as the most vulnerable period for leaf hopper infestation. The population tended to decrease with crop maturity, indicating a positive correlation between leaf hopper abundance and the age of the crop. Treatment-wise analysis revealed that, maximum leaf hopper population occurred in 20th July (0.85) followed by 25th June (0.84) across all 12 counts, while the minimum leaf hopper population was observed in 10th August (0.44) followed by 30th July (0.55) leaf hopper per leaf respectively. Furthermore, among the two varieties, JLT-408 exhibited a higher leaf hopper population than Prachi in all counts. Overall results from table 1 concluded that, treatment D5 recorded low leaf hopper count as compared with other treatments. Statistically leaf hopper population showed that, treatment D5 was significantly superior and it is at par with treatment D4.

Similar outcomes were reported by [1] observed peak leaf hopper infestation in meteorological weeks 32, 34, 36, and 37. Investigate on the seasonal incidence of insects and pests affecting sesamum, the study reported that *Orosius albicinctus*, identified as a leaf hopper, exhibited peak infestation during the 36th meteorological week. Consequently, crops sown in the 35-36 meteorological week were found to transmit the highest incidence of phyllody disease [7].

Effect of different dates of sowing on disease incidence

Results on the impact of sowing dates on sesamum phyllody disease incidence in varieties JLT-408 and Prachi are presented in table 2. Regards with varieties, the minimum mean disease incidence (10.30%) was recorded in Prachi, while the maximum disease incidence (16.58%) was in JLT-408. Disease incidence was not observed in any treatment up to 45 days after sowing, becoming evident uniformly at the 45-day mark across all sowings. This suggests that sesamum phyllody disease is primarily observed during the flowering stage, around 45 days after sowing, and tends to increase in the later stages of crop growth. Among all the sowing dates, the highest disease incidence occurred in the 20th July sowing (D3) in all counts and across all sowing dates, followed by D1 (25th June). The average mean of all counts was calculated and presented in table 2, revealing that treatment D3 (20th July) recorded the highest disease incidence (21.60%) followed by D1 (25th June) then after D2 (10th July) respectively. While the minimum disease incidence (6.64%) was reported in D5 (10th August) followed by D4 (30th July) sowing. This implies that, early sowing promotes disease development, and late sowing in month of August is considered the most suitable timeframe for sesamum cultivation to manage sesamum phyllody disease. Statically disease incidence data state that, treatment D5 was significantly superior than the other treatments and it is at par with D4. The treatment D2 is superior than the treatment D1 and it is at par also. The research finding also concluded that, delay in sowing date reduced disease incidence of sesamum phyllody after last week of July [4,6]. The results on effect of variety and sowing date with sesamum yield was presented in table 2. The yield of sesamum crop was found to be depends on phyllody disease incidence and variety use for cultivation. Crops sown in the late kharif season, specifically on 10th August (D5), recorded the highest yield at 810 kg/ha, followed by D4 (30th July) at 740 kg/ha. Minimum yield was recorded in D3 (20th July) at 507 kg/ha then after D1 (25th June) at 635 kg/ha (Figure 2). Among the cultivars, Prachi produced highest yield at 650 kg/ha, whereas JLT-408 was 430 kg/ha.

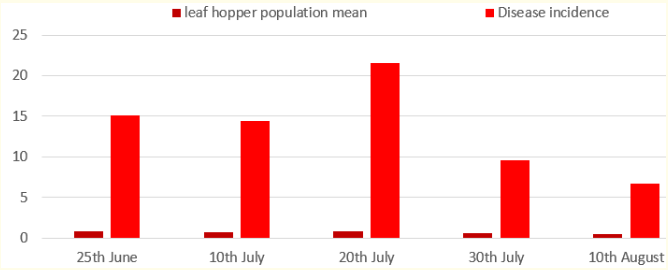

Figure 1: Relationship between leaf hopper population and disease incidence

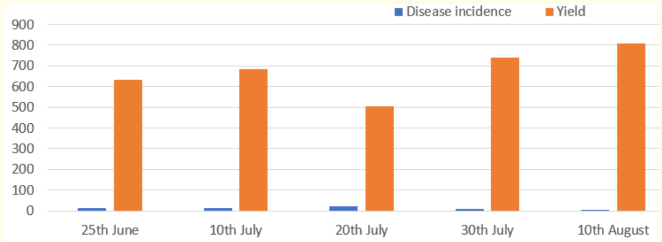

Figure 2: Effect of different sowing dates on sesamum phyllody disease incidence and yield.

Variety	Number of leaf hopper/leaf												Mean
	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS	63 DAS	70 DAS	77 DAS	84 DAS	
JLT-408	0.00	0.00	0.02	0.33	0.82	1.04	1.28	1.27	1.32	1.37	1.39	1.29	0.84
Prachi	0.00	0.00	0.01	0.34	0.52	0.67	0.85	0.82	0.85	0.78	0.77	0.68	0.52
Sowing dates													
D_1:(25th June)	0.00	0.00	0.03	0.37	0.84	1.01	1.21	1.25	1.31	1.35	1.41	1.30	0.84
D_2:(10th July)	0.00	0.00	0.02	0.34	0.58	0.92	1.03	1.10	1.18	1.19	1.29	1.19	0.73
D_3:(20th July)	0.00	0.00	0.01	0.34	0.80	0.95	1.35	1.29	1.37	1.42	1.41	1.30	0.85
D_4:(30th July)	0.00	0.00	0.00	0.36	0.70	0.73	0.90	0.83	0.83	0.83	0.76	0.67	0.55
D_5:(10th August)	0.00	0.00	0.02	0.28	0.44	0.63	0.83	0.77	0.73	0.60	0.54	0.48	0.44
V × D (Interaction effect)													
S.E. ±	0.00	0.00	0.03	0.21	0.17	0.11	0.07	0.07	0.06	0.05	0.02	0.06	0.07
C.D. @ 5%	0.00	0.00	0.10	0.63	0.51	0.34	0.22	0.23	0.20	0.16	0.08	0.17	0.22

Table 1: Leaf hopper population dynamics as influenced by different dates of sowing in sesamum.

Varieties	Disease incidence %				Mean		Yield (Kg/ha)
	45 DAS	55 DAS	65 DAS	75 DAS	Disease incidence (%)	Leaf hopper/ leaf	
JLT-408	7.71 (16.12)	13.24 (21.33)	20.29 (26.77)	25.09 (30.05)	16.58 (24.02)	0.84	430
Prachi	5.06 (12.99)	7.93 (16.35)	12.76 (20.92)	15.48 (23.16)	10.30 (18.71)	0.52	650
SE ±	0.20	0.14	0.34	0.28	--	--	--
C.D. @ 5%	0.60	0.41	1.02	0.85	--	--	--
Sowing dates							
D1 (25th June)	5.79 (13.92)	9.81 (18.25)	19.97 (26.54)	24.72 (29.81)	15.07 (22.84)	0.84	635
D2 (10th July)	5.56 (13.68)	13.16 (21.27)	17.41 (24.66)	21.00 (27.27)	14.39 (22.29)	0.73	683
D3 (20th July)	12.96 (21.10)	16.96 (24.31)	25.76 (30.50)	30.75 (33.67)	21.60 (27.69)	0.85	507
D4 (30th July)	4.61 (12.39)	7.76 (16.17)	11.16 (19.51)	14.95 (22.74)	9.52 (17.97)	0.55	740
D5 (10th August)	3.02 (10.00)	5.24 (13.23)	8.33 (16.77)	10.00 (18.43)	6.64 (14.93)	0.44	810
SE ±	0.32	0.22	0.54	0.45	--	--	--
C.D. @ 5%	0.95	0.66	1.61	1.34	--	--	--
V X D (Interaction effect)							
SE ±	0.45	0.31	0.77	0.64	--	0.07	--
C.D. @ 5%	1.35	0.93	2.28	1.90	--	0.22	--

Table 2: Effect of different dates of sowing on sesamum phyllody disease incidence, leaf hopper population and yield of sesamum crop. (Figures on parentheses are arcsine transformed values).

Conclusion

Sesamum phyllody poses a substantial threat to sesame crops, resulting in significant economic losses. Traditional methods involving insecticides and tetracycline have proven inadequate in managing this phytoplasmal disease. However, a strategic approach centered around the timing of sowing presents a promising avenue for disease management. The careful selection of sowing dates emerges as a critical factor in disrupting the disease cycle, reducing vector population and mitigating the impact of Sesamum phyllody. Notably, choosing to sow sesame crops in late kharif season on the 10th of August has demonstrated effectiveness in controlling vectors and directly controlling disease incidence as well as increasing yield.

Acknowledgement

We all authors highly appreciate the head and scientist of Oilseed Research Station (ORS), Latur for providing the seed material and guidance for conduction of research work.

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