

Original Research Article

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Field Evaluation of Different Fungicides for their Effectiveness against Phytophthora Blight Disease of Sesame (*Sesamum indicum* L.)

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ABSTRACT

Sesame (*Sesamum indicum* L.) is one of the important oilseed crops which are usually grown under rainfed condition on marginal lands in India. In Assam, the crop is grown in different parts of the state during summer and *kharif* season. The crop sesame is infected by several fungal, bacterial as well as phytoplasma diseases in the field grown in both the seasons, however, the *kharif* sesame which covers most of the sesame growing areas of the state often encountered by Phytophthora blight (*Phytophthora parasitica* var. sesame) due to frequent rainfall during the month of August-September which generally coincides with the early growth stage of the crop causing severe mortality of young seedlings as well as leaf blight in standing crops inflicting heavy yield losses. Considering the seriousness of the disease and the importance of the crop, particularly in the Upper Brahmaputra Valley Zone of Assam, an experiment was conducted during 2016-17 and 2017-18 to evaluate the best fungicide against the disease in the field. Fungicides like Matalaxyl + mancozeb, Copper oxychloride, Fosetyl-Al, Mancozeb and Chlorothalonil were tested to evaluate their effectiveness against Phytophthora blight of sesame in the field condition. Out of all the tested fungicides, Matalaxyl + mancozeb (0.20%) was found to be the most effective fungicide in reducing highest (64.17%) PDI over control followed by Fosetyl-Al (0.15%), Copper oxychloride (0.20%) and Mancozeb (0.20%) with 57.75 %, 49.49% and 44.84% reduction of PDI over control, respectively.

Keywords

Percent disease intensity, phytophthora blight, *kharif* sesame, fungicide, rainfed

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Introduction

Sesame (*Sesamum indicum* L.) is one of the important oilseed crops usually grown under rainfed condition on marginal lands in India. In Assam sesame is grown both as summer as well as *kharif* crop. In India it occupies an area

of 14.20 lakh hectare accounting production of 6.89 Lakh tone with productivity of 485 kg ha⁻¹ (Ministry of Agriculture, Govt. of India). In Assam, the crop is grown in an area of 12172 ha with a production of 9232 tonne and productivity of 758 kg ha⁻¹. Sesame has excellent cooking, medicinal, cosmetic and

nutritional qualities and its seed is a rich source of oil (50%) and protein (24%). Sesame oil primarily contributes olic, linolic, palmitic and steric fatty acids. Productivity of Sesame in India is very low compared to China and Egypt. Among other factors responsible for low productivity, attack of disease is one of the important factors.

The crop sesame is infected by several fungal, bacterial as well as phytoplasma diseases in the field grown in both summer as well as *kharif* seasons. Out of all the diseases, the Phytophthora blight caused by *Phytophthora parasitica* var. sesame is an economically important disease appearing in all the sesame grown areas in the country. The *kharif* sesame which covers most of the sesame growing areas of the state, particularly in the Upper Brahmaputra Valley Zone of Assam often encountered by Phytophthora blight disease due to frequent rainfall during the month of August-September which generally coincides with the early growth stage of the crop causing severe mortality of young seedlings as well as cause leaf blight symptoms in standing crops inflicting heavy yield losses. The disease was first reported from India (Butler, 1918). The disease appears in severe proportion in the states of Gujarat, Madhya Pradesh and Rajasthan, U.P and moderate in Punjab, Haryana, Maharashtra, Andhra Pradesh, Tamil Nadu, West Bengal and Bihar (Verma, 2002, Kale and Prasad, 1957). Singh *et al.*, (1976) reported that the disease may lead to mortality of plants as high as 72 to 79%. The yield loss due to this disease varied from 66.0 % in Gujarat to 79.8 % in Central Madhya Pradesh (Verma *et al.*, 2005).

The disease may occur at any stage of the crop; however, it becomes very serious when infection occurs at the seedling stage and kills the affected plants. The mortality of plants due to this disease may be as high as 72 to 80 % (Singh *et al.*, 2005). It may cause 100 % yield

loss when infection occurs at seedling stage under the most favourable conditions.

The initial symptom of the disease appears as water soaked spots on leaves and stems which are chestnut brown in the beginning and later turn into black causing premature leaf fall. The disease becomes sever under continuous rainy days affecting all the aerial parts of plants and covers whole field within few days, main root is affected, diseased plants are easily pulled out and produce shrivelled seeds and gives blighted appearance. The spots are brown in the beginning which later turns to black. Disease can attack at all the stages of the crop (Roy *et al.*, 2007).

Different management practices are used to control plant diseases caused by various pathogens, however, application of chemical fungicides remains to be the first choice for the farmers to manage diseases in different crops because of their easy availability, adaptability and immediate therapy. Fungicides are mostly applied to control different diseases of sesame, including the Phytophthora blight caused by *Phytophthora parasitica* var. sesame. Kalita *et al.*, (2002) reported that spraying of 0.3% Fytolan (Copper oxychloride) at 20, 40 and 60 days after sowing effectively controlled the disease and thereby reduced the yield loss.

Gupta *et al.*, (2018) reported that seed treatment with Thiram (0.2%) +Carbendazim 50WP (0.1%) along with foliar spray with wettable sulphur (0.2%) was found most effective to minimize the incidence of powdery mildew. In case of bacterial diseases seed treatment with Streptocycline (250-300ppm) was found to be most effective. Seed treatment with Thiram (0.2%) + Carbendazim 50WP (0.1%) and two foliar sprays of (Mancozeb 2%+ Carbendazim1%) was effective in reducing the Alternaria and Cercospora disease and recorded highest yield.

Seed treatment with Imidacloprid (@ 5 ml kg⁻¹ seed) followed by foliar spray of Thiomethaxam @ 0.2 g l⁻¹ was found effective in reducing the vector population and sesame phyllodydisease incidence.

Ermiasand Dagne (2021) tested several fungicides against *Cercospora* leaf spot disease of Sesame in Ethiopia. Out of which Tilt 250 EC was found to be the most effective fungicide in controlling the disease with lowest (5.00%) disease severity and resulted highest grain yield (618.98 kg ha⁻¹). Khalifa (1997) also reported that Rizolex-f or Benlate as seed treatment +Chlorneb as soil treatment were found superior for controlling root rot and wilt diseases and increased seed yield of sesame under field conditions

Application of biopesticides has shown encouraging result in managing the *Phytophthora* blight disease of sesame. Application of *Trichoderma viridae*, *T. harzianum* and *Pseudomonas fluorescens* as seed treatment has reduced the disease significantly and increased the yield substantially (Verma, 2002). Seed treatment with *Trichoderma viride*@4g kg⁻¹seed, *Pseudomonas fluorescens* @ 10gkg⁻¹ seed or *Bacillus subtilis* @ 10gkg⁻¹ seed and Neem seed kernel extract (NSKE) 5% was found helpful controlling soil borne pathogens (Augstburger *et al.*, 2000).Gupta *et al.*, (2018) also found that Seed treatment with *T. viride* (5gkg⁻¹seed and soil application of *T. viride* @ 2.5 kg ha⁻¹ was found effective and economical for the management of *Macrophomina* root /stem rot of sesame.

Cultivation of resistant varieties was also found to be the most effective and cheap method to combat the disease as compared to chemical or biological control (Basavaraj *et al.*, 2009). Mutant varieties resistance to *Phytophthora* in sesame has been developed in the Republic of Korea (Ashri, 2001) and Sri

Lanka (Bedigian, 2010). In India also, several research workers screened sesame germplasm against powdery mildew disease (Sushama Nema and Duhoon, 2008; Padma Sundari and Kamala, 2012).

Pathirana (1992) screened the induced mutant population of sesame against *Phytophthora* disease under natural epiphytotic condition. Sesame variety tolerant to *Phytophthora* blight disease was also developed by Pathirana *et al.*, (2000).

The use of resistant genotypes was a long-term solution to control this problem(Ranganatha *et al.*, 2012).In Korea, a black sesame variety 'Kangheuk' was developed by hybridization followed by pedigree selection with *Phytophthora* blight resistance and high yielding (Shim *et al.*, 2012). Verma *et al.*, (2005) observed that persistence of continuous rain and humid weather for a longer period during sowing to seedling establishment stage favours the disease. Further, they opined that high humidity for a longer period and temperature range of 25-35⁰C is necessary for disease development but the pathogen failed to grow at temperature above 35⁰C. Harilal *et al.*, (2015) screened several sesame entries for field resistance against *Phytophthora* blight disease under natural epiphytotic conditions and reported that Gujarat Til 10 (GT 10) found superior against *Phytophthora* blight disease with disease intensity ranging from 3.74 and 5.92% under high disease presser condition.

The variety GT 10 also showed statistically equal yield performance to other check varieties. Considering the seriousness of the disease and importance of the crop, particularly in the Upper Brahmaputra Valley zone of Assam, the present investigation was made to evaluate the best fungicide in managing the *Phytophthora* blight disease of sesame under field condition.

Materials and Methods

Field Experiment was carried out at farmer's field under Cluster Frontline Demonstration (CFLD) of Krishi Vigyan Kendra, Lakhimpur, Assam, India during the *kharif* season of 2016-17 and the same experiment was repeated during *kharif*, 2017-18. The field experiment was conducted in Randomized Block Design (RBD) with six treatments and four replications were maintained for each treatment.

The experimental field was prepared by proper ploughing and harrowing and individual plot of size 8 x 4 m² was prepared.

All the agronomic practices as recommended in Package of Practices (*Kharif*), published jointly by Department of Agriculture, Government of Assam and Assam Agricultural University (AAU), Jorhat were followed. The sesame cultivar *Bahuabheti* was used for the present investigation. Seeds were sown uniformly in all the plots and the crop was thinned at 15-20 days after germination maintaining a plant to plant distance of 10 cm. Several fungicides viz. Metalaxyl 8% wp + mancozeb 63% wp (0.20%), Mancozeb 75% wp (0.20%), Fosetyl-Al 80% wp (0.15%), Copper oxychloride 50% wp (0.20%) and Chlorothalonil 75 % wp (0.1%) were evaluated for their efficacy against the Phytophthora blight disease under field condition. The first spray of these above mentioned fungicides were given immediately after appearance of initial symptoms developed on lower leaves; subsequently two sprays with these fungicides were given at 15 days interval. Leaf infections of Phytophthora blight disease was assessed on randomly selected twenty five plants from each plots under natural conditions after one week of last spray using 0 to 5 rating scale (Rajpurohit, 1993). The Percent Disease Intensity (PDI) was calculated according to Wheeler (1969). The seed yield was also recorded and

expressed in kg ha⁻¹.

$$PDI = \frac{\text{Sum of individual rating}}{\text{Total no of leaves examined}} \times \frac{100}{\text{Maximum grade in the rating scale}}$$

Statistical Data Analysis

The experimental data collected were analyzed statistically for its significance of difference by the normal statistical procedure adopted for randomized block design and interpretation of data was carried out by OPSTAT package of programs (Sheoran, 2006) after angular transformation. The treatment means were compared by Duncan's Multiple Range Test (DMRT).

Results and Discussion

The pooled data presented in Table 1 revealed that all the treatments (fungicides) significantly reduced the intensity of Phytophthora blight in sesame. Minimum PDI (22.32 %) was recorded in matalaxyl + mancozeb (0.20%) sprayed plots which was followed by Fosetyl-Al (0.15%), Copper oxychloride(0.20%) and Mancozeb (0.20%) treated plots with 26.32 %, 31.46 % and 34.36 % PDI, respectively while, Chlorothalonil (0.20%) was found least effective against Phytophthora blight of sesame with maximum (41.52 %) PDI. However, the result of Matalaxyl + mancozeb (0.20%) was at par with that of Fosetyl-Al (0.15%) in terms of PDI. Likewise, the result of Copper oxychloride(0.20%) and Mancozeb (0.20%) was also at par in regards to PDI.

Highest reduction(64.17%) of PDI over control was recorded in the Matalaxyl + mancozeb (0.20%) treated plot followed by Fosetyl-Al (0.15%), Copper oxychloride(0.20%) and Mancozeb (0.20%) treated plots with 57.75 %, 49.49% and 44.84% reduction of PDI over control, respectively. The lowest reduction (33.34%) of PDI over control was observed in Chlorothalonil (0.20%) treated plot.

Table.1 Efficacy of fungicides on disease intensity of Phytophthora blight of sesame.

Treatments	Percent Disease Intensity(PDI)			Reduction of PDI over control (%)
	2016-17	2017-18	Pooled PDI	
T1= Metalaxyl + mancozeb	26.18(30.75) ^d	18.46(25.37) ^d	22.32(28.06) ^d	64.17
T2=Copper oxychloride	34.28(35.82) ^{bc}	28.64(32.32) ^c	31.46(34.06) ^c	49.49
T3=Fosetyl- Al	30.28(33.34) ^{cd}	22.36(28.19) ^d	26.32(30.74) ^d	57.75
T4=Mancozeb	36.44(37.12) ^b	32.28(34.59) ^c	34.36(35.84) ^c	44.84
T5=Chlorothalonil	38.68(38.45) ^b	44.36(41.75) ^b	41.52(40.08) ^b	33.34
T6=Control	60.46(51.05) ^a	64.12(53.22) ^a	62.29(52.12) ^a	
SEd ±	1.56	1.59	1.44	
CD(P=0.05)	3.35	3.43	2.97	

Data within parenthesis are angular transformed values

Table.2 Efficacy of different fungicides on seed yield of sesame.

Treatments	Seed yield (kg ha ⁻¹)		
	2016-17	2017-18	Pooled Yield
T1= Metalaxyl + mancozeb	994 ^a	984 ^a	989 ^a
T2=Copper oxychloride	882 ^c	834 ^c	858 ^c
T3=Fosetyl- Al	973 ^b	962 ^b	967 ^b
T4=Mancozeb	746 ^d	726 ^d	736 ^d
T5=Chlorothalonil	638 ^e	614 ^e	626 ^e
T6=Control	412 ^f	394 ^f	403 ^f
SEd ±	6.28	6.44	5.81
CD(P=0.05)	13.52	13.85	11.99

The pool data exhibited in the Table 2 showed that the seed yield was also increased in all treatments. Highest mean seed yield was obtained in Metalaxyl+ mancozeb (989 kg ha⁻¹) treated plot which was followed by Fosetyl-Al (0.15%), Copper oxychloride(0.20%) and Mancozeb (0.20%) treated plots with a seed yield of 967 kg ha⁻¹, 858 kg ha⁻¹ and 736 kg ha⁻¹, respectively while, the plot treated with Chlorothalonil (0.20%) recorded the least (626 kg ha⁻¹) seed yield. In the present investigation, three sprays of Metalaxyl + mancozeb (0.20%), first immediately after appearance of initial symptoms and subsequent two sprays at 15 days interval was found to be the most effective against

Phytophthora blight of sesame. This was in conformity with the findings of Minuto *et al.*, (2000) who tested several fungicides against *Phytophthoranicotianae* var *parasitica* causing root rot disease of lavender, among different fungicides tested, Metalaxyl showed the best efficacy for the control of Phytophthora root rot.

Sharma *et al.*, (1970) tested ten different fungicides among them, Dithan M-45 which was the most economic for control of buckeye rot of tomato caused by *Phytophthoranicotianae* var *parasitica*. Farih and Jrifi (1998) also reported that Metalaxyl and Fosetyl- Al effectively control

Phytophthora citrophthora causing brown rot in citrus. Vyas (1981) reported that application of dithiocarbamate fungicides such as Mancozeb (0.30%) or Zineb (0.30%) were found effective for the control of *Phytophthora* blight of sesame.

Application of Metalaxyl + mancozeb (0.20%) also increased the seed yield which is due to the reduction of PDI as witnessed in the present investigation which was in conformity with the findings of several other researchers. A mixture of Metalaxyl + mancozeb (0.20%) applied at 14 and 21 days interval in potato crop against *Phytophthora infestans*, improve yield by 19.8 and 13.11%, respectively (Anonymous, 1979).

Metalaxyl + mancozeb (0.20%) was found to be the most effective fungicide against *Phytophthora* blight of sesame with lowest (22.32 %) PDI followed by Fosetyl-Al (0.15%), Copper oxychloride (0.20%) and Mancozeb (0.20%) with 26.32 %, 31.46 % and 34.36 % PDI, respectively. Highest mean seed yield (989 kg ha⁻¹) was obtained in Metalaxyl+ mancozeb treated plot followed by Fosetyl-Al, Copper oxychloride and Mancozeb treated plots with a seed yield of 967 kg ha⁻¹, 858 kg ha⁻¹ and 736 kg ha⁻¹, respectively.

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