RESEARCH ARTICLE

BIOPRIMING AND INTEGRATED MANAGEMENT OF MAJOR DISEASES OF SESAME

B. Meena*

Regional Research Station, Tamil Nadu Agricultural University, Vridhachalam – 606 001, Tamil Nadu

Received-02.05.2021, Revised-12.05.2021, Accepted-27.05.2021

Abstract: Sesame (*Sesamum indicum* L.) is one of the important oilseed crop grown widely under tropical and subtropical regions in India Diseases pose a major constraint in sesame cultivation that leads to yield loss. Various modules were evaluated for the management of major diseases in sesame. From the results, it was found that the module comprising of seed treatment with *Trichoderma asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by foliar application of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS significantly reduced the root rot, phyllody, *Alternaria* leaf spot and powdery mildew diseases. In addition to disease reduction, seed yield was also found to be enhanced in the effective module.

Keywords: Sesame, Diseases, Biopriming, Modules

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest oilseed crop grown widely under tropical and subtropical regions in India. Its seeds are rich in oil (50 to 52%), protein (17 to 19%) and carbohydrate (16 to 18%) (Schilling and Catan, 1991). The low productivity in sesame is attributed to poor crop management and exposure of the crop to a number of biotic and abiotic stresses. Sesame is also known as generally, "Til", popularly as "Queen of Oilseeds" due to its stabilized keeping quality contributed by high degree of resistance to oxidation (Bedigian and Harlan, 1986).

Despite the potential for increasing the production and productivity of sesame, there are a number of challenges inhibiting sesame production and productivity. There are severe biotic stresses, such as root rot /stem rot (*Macrophomina phaseolina)* (Tassi) Goid, (Bacterial blight (*Xanthomonas campestris* pv. sesame), phyllody (a Mycoplasma – like organism), powdery mildew (*Oidium erysiphoides), Alternaria* leaf spot *(Alternaria sesame*) and *Cercospora* leaf spot (*Cercospora sesame*). Sesame diseases cause damage to seed, seedling, root, stem as well as foliage resulting in significant loss.

Stem and root rot disease is caused by *Macrophomina phaseolina* (Tassi) Goid (Mihail, 1995). The disease causes severe losses right from seedling to maturity of the crop (Khan, 2007). Maiti *et al*. (1988) reported an estimated yield loss of 57% at about 40% of disease incidence. The symptoms were produced at ground level stem becomes black, which extends upward rupturing the stem and black dots appear on the infected stem. The roots will become brittle. In disease infected plants, black capsules are seen which open prematurely exposing shrivelled seed. Cercospora leaf spot disease is caused by (*Cercospora sesami* Zimm) is one of the most economically important diseases of sesame in almost all the production area. Extensive infection of foliage and capsule leads to defoliation and damage of sesame capsule and yield losses may range from 22 to 53% (Enikuomehin *et al.*, 2002).

Powdery mildew caused by *Erysiphae orantii Cast* (Rajpurohit, 1993) is the most important disease of sesame, occurring widely throughout India and causes substantial qualitative and quantitative loss to the crop. It occurs in epidemic scale under heavy rainfall condition followed by low night temperature and high humidity. Powdery mildew causes yield losses ranging from 25 to 50% depending upon the level of incidence.

Alternaria leaf spot disease caused by (*Alternaria sesami*) is one of the most common and economically important foliar diseases of sesame. The disease reported in different sesame growing parts of the country by many workers (Dolle, 1984). It affects the plants at all stages and symptoms produced are small dark brown water soaked, round to irregular lesions with concentric rings varying from 1-8 mm in diameter (Mohanti and Behera, 1958).

Phyllody is a serious and wide spread disease of sesame caused by a pleomorphic mycoplasma–like organism (MLOs) which is now called as phytoplasma (Choopanya, 1973). The phyllody is transmitted by the insect vector *Orosisius albicinctus*. The infected plant is characterized by transformation of all floral parts in to green leafy structures followed by abundant vein clearing in different flower parts. In severe infection, the entire inflorescence is replaced by short twisted leaves closely arranged on a stem with short internodes and abundant abnormal branches bend down. Finally, plants look like witches broom. The losses as high as 90% has been reported by Gopal *et al*., 2005.

*Corresponding Author

At present chemical fungicides are the first choice for the farmers to combat diseases because of their easy adaptability and immediate therapy. Due to health risk and pollution hazards by use of chemical fungicides in plant disease control, it is considered appropriate to minimize their use. Since sesame seed and oil are in high demand for export due to their high unsaturated fat and methionine content, focus has been shifted out safer alternatives to chemical fungicides in recent years. Biological control had attained importance in modern agriculture for disease control. The use of eco-friendly pest control method has got tremendous scope since the diseases are controlled without putting any threat to the quality of produce and surrounding ecosystem. Integrated Disease Management (IDM) that incorporates the biocontrol agents, botanicals and organic amendments would reduce the amount of fungicides used per season in addition to combat diseases in an economically viable and ecologically safe proportion. Hence, the present study was undertaken to evaluate various modules for the management of major diseases in sesame.

MATERIALS AND METHODS

Isolation, Purification and Multiplication of culture

Sesame (*Sesamum indicum* L.) plants showing typical root rot, leaf blight symptoms were collected and the isolation of fungi were done following the standard tissue isolation technique. Those parts of root, stem and leaves showing typical symptoms of the disease were washed in running tap water and cut into small bits. These bits were surface sterilized with 0.1 per cent mercuric chloride solutions for 30 seconds and washed thoroughly in sterile distilled water for three times to remove traces of mercuric chloride and then aseptically transferred to sterilized potato dextrose agar (PDA) plates and incubated at 27±1ºC for three days for fungal growth. Later, the bit of fungal growth was transferred to PDA slants. The pure culture of the fungus was obtained by further growing the culture under aseptic conditions by following hyphal tip culture method (Rangaswami, 1972). After seven days of incubation, pure isolates were obtained and maintained at 4ºC for further studies.

Field studies for the management of major diseases of sesame

The field experiments were conducted in the experimental farm of Regional Research Station, Vridhachalam in a plot size of 2.4x 3.0 m during 2019 and 2020 with four modules and five replications in Randomized block design for the management of major diseases of sesame. The susceptible variety VRI-1 was used for the evaluation of the following modules.

Treatment Modules

Modules	Treatment details
M_1-Biointensive	Seed treatment with *Trichoderma asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by spray of *Pseudomonas fluorescens* @ 10 g/l at 30-35 DAS & wettable sulphur @ 2 g/l at 50-60 DAS
M_2-Chemical	Seed treatment with carbendazim @ 2 g/kg followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS
M_3-Adoptive	Seed treatment with *T. asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS
M_4-Untreated check	Control

Sesame seeds were treated with bioagent, *Trichoderma asperellum* @ 10 g/kg seed or fungicide, carbendazim @ 2 g/kg seed. Furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha was also made. Foliar application of *Pseudomonas fluorescens* @ 10 g/l at 30-35 DAS; wettable sulphur @ 2 g/l at 50-60 DAS were also done. Foliar application was also made with combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS. The plants which did not receive any treatment served as the control.

The root rot and phyllody disease incidences were recorded at 90 days after sowing by counting the number of diseased plants and total plants.

Per cent disease incidence was calculated using the formula

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

The occurrence of foliar diseases *viz*., powdery mildew and *Alternaria* leaf spot were recorded at weekly intervals using 0-5 scale (0 - No infection; 1 - 1 to 10% leaf area infected; 2 -11 to 25% leaf area infected; 3 - 26 to 50% leaf area infected; 4 - 51 to

75% leaf area infected; 5 - 76 to100% leaf area infected) (Anonymous, 1998). Disease intensity was recorded on the basis of 25 plants selected randomly from each replication.

Per cent disease index (PDI) was calculated using the formula

$$\text{PDI} = \frac{\text{Sum of numerical ratings}}{\text{Number of plants observed} \times \text{Maximum grade}} \times 100$$

RESULTS AND DISCUSSION

The results of the field experiment conducted during 2019 revealed that Module III (M_3) – Seed treatment with *T. asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS was effective in managing the major diseases of sesame which recorded minimum root rot disease incidence (20.7%), phyllody incidence (21.9%), leaf spot (11.6 PDI) and powdery mildew (18.2 PDI).The maximum seed yield of 632 kg/ha was recorded in the effective Module III (Table 1). This was followed by Module II (M_2) comprising of seed treatment with carbendazim @ 2 g/kg followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS which recorded root rot disease incidence (25.1%), phyllody incidence (26.3%), *Alternaria* leaf spot (14.9 PDI) and powdery mildew (26.7 PDI). The seed yield of 584 kg/ha was obtained in this Module II. In control, the maximum root rot disease incidence (42.3%), phyllody incidence (36.4%), leaf spot (20.3 PDI) and powdery mildew (34.6 PDI) and minimum seed yield of 483 kg/ha were recorded (Table 1). Harman (2006) highlighted that *Trichoderma* acts as inducer for resistance in treated plants against certain pathogens. Balode (2010) reported that *Trichoderma* spp. is known to act through different mechanisms ranging between mycoparasitic or through production of antifungal substances such as trichodermin.

The evaluation of various modules against major diseases of sesame during 2020 revealed that Module III (M_3) – Seed treatment with *T. asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS was effective in managing the major diseases of sesame which recorded minimum root rot disease incidence (20.4%), phyllody incidence (16.8%), *Alternaria* leaf spot (8.5 PDI) and powdery mildew (17.3 PDI). The maximum seed yield of 592 kg/ha was recorded in the effective Module III (Table 2). In control, the maximum root rot disease incidence (38.6%), phyllody incidence (28.4%), *Alternaria* leaf spot (18.7 PDI) and powdery mildew (30.9 PDI) and minimum seed yield of 502 kg/ha were observed (Table 2).

From the results of the pooled mean of the field experiments conducted during 2019 and 2020, it was found that Module III (M_3) – Seed treatment with *T. asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by spray of combi product (Tebuconazole 50% + Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS significantly reduced the diseases of sesame *viz*., root rot (22.3%), phyllody (19.3%), *Alternaria* leaf spot (10.1PDI) and powdery mildew (17.7 PDI) and increased the seed yield (612 kg/ha) (Table 3). The maximum root rot (40.4%), phyllody (32.4%), *Alternaria* leaf spot (19.5 PDI) and powdery mildew (32.7 PDI) diseases and minimum seed yield (492 kg/ha) were observed in the control (Table 3). Gayathri and Indra (2003) reported that soil application of neem cake along with seed treatment and soil application of *T. viride* significantly reduced the groundnut collar rot than seed and soil application of *T. viride* alone. Jeyalakshmi *et al.* (2013) reported that soil application of *T. viride* and neem cake exhibited maximum disease suppression when applied in combination than alone. Seed treatment with biocontrol agents provide longer protection than chemicals and suppress the seed and soil-borne pathogens only in early stage of the crop growth was highlighted by Jeyalakshmi *et al.* (2013).

Guleria and Kumar (2006) documented that increased biosynthesis of phenols in sesame plants sprayed with neem leaf extract are responsible for the drastic reduction of *Alternaria* leaf blight. Harman *et al.* (2004) and Haikal (2008) also observed similar effects of *T. viride* in different crops. Papavizas and Lumsden (1980) highlighted that changes in soil reaction due to increased activity of introduced *Trichoderma* species might be one among the reasons for the increased seedling growth beside production of growth regulating substances by the antagonists. Meena and Ezhilarasi (2019) reported that seed treatment with *T. asperellum* was effective in managing root rot disease of sesame. The reduction of crown and root rot disease caused by *Fusarium solani* was obtained with *T. asperellum* as reported by Pastrana *et al.* (2016).

CONCLUSION

From the present study, it was concluded that the adoptive module comprising of seed treatment with *T. asperellum* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5 kg *Trichoderma* sp. + 100 kg Vermicompost) @ 250 kg/ha followed by foliar application of combi product (Tebuconazole 50% +

Trifloxysrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS was highly effective in managing major soil borne disease *viz*., root rot and foliar diseases *viz*., *Alternaria* leaf blight, powdery mildew and phyllody and increasing the seed yield.

Table 1. Evaluation of Modules for the management of major diseases of sesame (2019)

S. No	Modules	Root rot (%)	Phyllody (%)	*Alternaria* leaf spot (PDI)	Powdery mildew (PDI)	Seed yield (kg/ha)
1.	M_1-Biointensive	32.6 (34.7)	30.7 (33.6)	16.7 (24.0)	29.3 (32.7)	526
2.	M_2-Chemical	25.1 (29.9)	26.3 (30.7)	14.9 (22.6)	26.7 (31.0)	584
3.	M_3-Adoptive	20.7 (26.8)	21.9 (27.8)	11.6 (19.8)	18.2 (25.1)	632
4.	M_4-Untreated check	42.3 (40.5)	36.4 (37.1)	20.3 (26.7)	34.6 (35.9)	483
CD		5.9	4.2	3.8	5.1	58.7
SE(m)		1.9	1.3	1.2	1.6	18.8
SE(d)		2.7	1.9	1.8	2.3	26.6
CV		12.9	9.3	12.3	11.8	7.5

*Mean of five replications

Table 2. Evaluation of Modules for the management of major diseases of sesame (2020)

S. No	Modules	Root rot (%)	Phyllody (%)	*Alternaria* leaf spot (PDI)	Powdery mildew (PDI)	Seed yield (kg/ha)
1.	M_1-Biointensive	25.3 (28.6)	22.6 (25.4)	12.4 (15.7)	22.7 (25.6)	561
2.	M_2-Chemical	23.7 (26.2)	20.4 (23.6)	11.6 (14.9)	20.6 (23.4)	573
3.	M_3-Adoptive	20.4 (23.9)	16.8 (19.2)	8.5 (11.4)	17.3 (20.6)	592
4.	M_4-Untreated check	38.6 (35.2)	28.4 (31.6)	18.7 (21.2)	30.9 (27.4)	502
CD		2.4	2.8	3.1	2.6	18.6
SE(m)		1.5	1.3	1.5	1.4	8.1
SE(d)		1.6	1.9	1.8	1.7	8.7
CV		10.7	11.4	9.8	12.3	12.7

*Mean of five replications

Table 3. Pooled mean of 2019 & 2020 for the evaluation of Modules for the management of major diseases of sesame

S. No	Modules	Root rot (%)	Phyllody (%)	*Alternaria* leaf spot (PDI)	Powdery mildew (PDI)	Seed yield (kg/ha)
1.	M_1-Biointensive	28.9 (31.6)	26.6 (29.5)	14.5 (19.8)	26.0 (29.1)	543
2.	M_2-Chemical	24.4 (28.1)	23.3 (27.1)	13.2 (18.7)	23.6 (27.2)	578
3.	M_3-Adoptive	22.3 (25.3)	19.3 (23.5)	10.1 (15.6)	17.7 (22.8)	612
4.	M_4-Untreated check	40.4 (37.8)	32.4 (34.3)	19.5 (23.9)	32.7 (31.6)	492
CD		4.1	3.5	3.4	3.8	38.6
SE(m)		1.6	1.7	1.3	2.0	13.4
SE(d)		2.1	1.9	1.8	2.1	17.6
CV		11.8	10.3	11.1	12.1	10.1

*Mean of five replications

ACKNOWLEDGEMENT

The financial support rendered by ICAR – All India Co-ordinated Research Project on Sesame and Niger is gratefully acknowledged.

REFERENCES

Anonymous (1998). All India Co-ordinated Research Project on Sesame and Niger. Tech. Prog. and Guidelines for Implementation. Project Co-ordinating unit (sesame and niger) Jawaharlal Nehru Agricultural University, Jabalpur, M.P. (INDIA).

Balode, A. (2010). Effect of tricodermin, biological product against *Botrytis* in horticultural crops. *Acta horticulture*. 877: 1583-1588.

Bedigian, D. and Harlan, J.R. (1986). Evidence for cultivation of sesame in the ancient world. *Economic Botany*. 40: 137-154.

Choopanya, D. (1973). Mycoplasma-like bodies associated with sesame phyllody in Thailand. *Phytopathol*. 63: 1536-1537.

Dolle, U.V. (1984). Studies on leaf blight of sesame (*Sesamum inducum* L.) caused by *Alternaria sesame*. *Maysore J Agric Sci.* 18: 89-90.

Enikuomehin, O.A. and Peters, O.T. (2002). Evaluation of crude extracts from some Nigerian plants for the control of field diseases of sesame (*Sesamum indicum* L.). *Trop. Oilseeds J*. 84-93.

Gayathri, S. and Indra, N. (2003). Management of seed and collar rots caused by *Aspergillus niger* Van Tiegham in groundnut (*Arachis hypogaea* L.) by biocontrol method. *Madras Agricultural Journal*. 90: 292–297.

Gopal, K., Jagadeswar, R. and Prasad, G. (2005). Evaluation of sesame (*Sesamum indicum*) genotypes for their reaction to powdery mildew and phyllody diseases. *Plant Disease Research*. 20: 126-130.

Guleria, S. and Kumar, A. (2006). Biochemical basis of white stem rot (*Sclerotinia sclerotiorum*) resistance in Rapeseed-Mustard. *Journal of Oilseeds Research.* 23: 69-71.

Haikal, N.Z. (2008). Control of *Rhizoctonia solani* in Soybean (*Glycin max* L) by seed-coating with *Trichoderma viride* and *Gliocladium virens* spores. *Journal of Applied Biosciences*. 1: 34–39.

Harman, G.E. (2006). Overview of mechanisms and uses of *Trichoderma* spp. *Phytopathology*. 96:190-194.

Harman, G.E., Howell, C.R., Viterbo, A., Chet, I. and Lorito, M. (2004). *Trichoderma* species opportunistic, avirulent plant symbionts. *National Review of Microbiology*. 2: 43-56.

Jeyalakshmi, C., Rettinassababady, C. and Sushma, N. (2013). Integrated management of sesame diseases. *Journal of Biopesticides*. 6: 68-70.

Khan, S.N. (2007). *Macrophomina phaseolina* as causal agent for charcoal rot of sunflower. *Mycopathologia*. 5: 111-118.

Maiti, S., Hegde, M.R. and Chattopadhyay, S.B. (1988). Handbook of Annual Oilseed
Crops. Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.

Meena, B. and Ezhilarasi, T. (2019). Standardisation of *Trichoderma asperellum* as seed treatment in the management of root rot disease of sesame. *Int J Che Studies*. 7: 2176-2179.

Mihail, J.D. and Taylor, S.J. (1995). Interpreting variability among isolates of *Macrophomina phaseolina* in pathogenicity, pycnidium production, and chlorate utilization. *Can J Bot*. 73: 1596-1603.

Mohanti, N.N. and Behera, B.C. (1958). Blight of sesame caused by *Alternaria sesame*. New Comb. *Current Sci*. 27: 492-493.

Papavizas, G.C. and Lumsden, R.D. (1980). Biological control of soil-borne fungal propagules. *Annual Review of Phytopathology*. 18: 389-413.

Pastrana, A.M., Ureba, M.J.B., Aguado, A., Akdi, K. and Capote, N. (2016). Biological control of strawberry soil-borne pathogens *Macrophomina phaseolina* and *Fusarium solani*, using *Trichoderma asperellum* and *Bacillus* spp. *Phytopathologia Mediterranea*. 55: 109-120.

Rajpurohit, T.S. (1993). Occurrence, varietal reaction and chemical control of new powdery mildew (*Erysiphe orontii* cast) of sesame Zimin. *Indian J Mycol Pl Pathol*. 23: 207-307.

Rangaswami, G. (1972). Diseases of crop plants in India. Prentice Hall of India Pvt. Ltd.
New Delhi, 520p.

Schilling, R. and Cattan, P. 1991. Sesame cultivation in tropical Africa. *Oleaginenx*. 46: 129-131.