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Evaluation of plant extracts and plant essential oils against *Sclerotium oryzae* under *in vivo* conditions

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Abstract
Stem rot caused by *Sclerotium oryzae* is one of the major diseases of rice and a serious threat to rice production in India. In order to determine the bio efficacy of the botanicals and plant essential oils an experiment was conducted with eight treatments during *rabi* 2017-18. Among them, lowest per cent disease index (PDI) was observed in T1 (39.62 PDI) followed by treatments T2 (43.38 PDI) and T4 (45.45 PDI) which were statistically at par with each other. While in T8 significantly higher stem rot disease was recorded with 60.20 PDI followed by T7 (54.68 PDI) which were statistically at par with each other but differed significantly with all other treatments. Highest grain yield was recorded in T1 (7.145t/ha) followed by T2 (5.882 t/ha). Lowest yield was observed in T8 (5.354t/ha). Whereas, highest straw yield was recorded in T1 (8.016t/ha) followed by T3 (6.48t/ha) and T4 (6.43t/ha) which were statistically at par with each other. Lowest yield was observed in T8 (5.7.07t/ha).

Keywords: Plant extracts, essential oils, *S. oryzae*, rice, stem rot

1. Introduction
Stem rot incited by *Sclerotium oryzae* Catt. is one of the most devastating disease which prevails in all rice growing areas worldwide (Konthojam *et al*., 2007). It was first reported on rice from Italy in 1876 (Cattaneo, 1877) [2]. Worldwide 5-80 % yield loss has been reported due to this disease (Gopika *et al*., 2016) [5]. The use of synthetic fungicides to control disease pose various problems such as residue in feed and food, pathogen resistance (Deising *et al*., 2008) [14], toxicity to non-target organisms, environmental pollution (Arcury and Quandt, 2003) [1]. Natural plant products may reduce disease development by direct toxicity to pathogens, induction of systemic resistance (Kagale *et al*., 2004), stimulating beneficial organisms (Bowers and Locke, 2000) or inactivation of toxins produced by pathogens (Shanmugam *et al*., 2001). Hence it has become necessary to use eco-friendly formulations which can fit into integrated pest management. The present study was under taken to study the bio efficacy of the botanicals and plant essential oils on stem rot disease incited by *Sclerotium oryzae*, Catt.

2. Materials and Methods
A field experiment was conducted in randomized complete block design (RBD) at the experimental fields of Agricultural Research Station, Nellore, Andhra Pradesh during *rabi* 2017-18. A popular rice variety MTU 1010 which was susceptible to stem rot diseases was transplanted with a spacing of 15 x 15 cm in a gross plot size of 13.455 SQM. A check plot was also maintained. An experiment was conducted with eight treatments and three replications. The data on the disease incidence was recorded from the date of initial incidence of the disease, once in 15 days from maximum tillering to panicle emergence. Disease incidence and severity of stem rot before each spray and finally at late dough stage of the crop was recorded. Appropriate disease scores (0-9 scale of SES for Rice, SES, IRRI, 2013) or percentages for disease incidence was used.

PDI = [(Sum of the scores)/(Number of Observation X Highest Number in Rating Scale)] x 100

Table 1: The following treatments were imposed

S. No.	Treatment	Dosage (%)
1	Garlic *(Allium sativum)*	1.8
2	Mustard *(Brassica juncea)*	20
3	Turmeric *(Curcuma longa)*	15
4	Eucalyptus oil (*Eucalyptus globules*)	0.2
5	Lemon grass oil (*Cymbopogon citratus* L.)	0.01
6	Spear mint oil (*Mentha spicata*)	2.0
7	Mustard oil (*Brassica juncea* L.)	2.0
8	Control	--

3. Results and Discussion

In order to determine the bio efficacy of the botanicals and plant essential oils on stem rot disease incited by *Sclerotium oryzae*, Catt. An experiment was conducted using susceptible rice variety MTU 1010 with eight treatments and three replications during *rabi* 2017-18. Results of the study presented in table 2 and 3 revealed that, the per cent disease index of stem rot before spraying in all the treatments was ranged from 12.18 to 17.58, in which no significant difference was observed in all the treatments. At 15 days after the first spraying, T1 (*Allium sativum*) showed lowest per cent disease index (PDI) of 35.62 which was followed by T2 (*Brassica juncea*; 38.25 PDI), T4 (Eucalyptus oil; 38.78 PDI) and T5 (Lemon grass oil; 41.75 PDI) which were statistically at par with each other. The control (T8) with 46.01 PDI which was statistically at par with the treatments T6 (Spear mint oil; 44.09 PDI), T7 (Mustard oil; 43.86 PDI) and T3 (*Curcuma longa;* 43.78 PDI).At 15 days after the second spraying, lowest per cent disease index (PDI) was observed in T1 (*Allium sativum*; 39.62 PDI) followed by treatments T2 (*Brassica juncea;* 43.38 PDI) and T4 (Eucalyptus oil; 45.45 PDI) which were statistically at par with each other. While in T8 (control) significantly higher stem rot disease was recorded with 60.20 PDI followed by T7 (Mustard oil; 54.68 PDI) which were statistically at par with each other but differed significantly with all other treatments. The stem rot PDI in treatments T3 (*Curcuma longa*), T5 (Lemon grass oil) and T6 (Spear mint oil) ranged from 47.94 to 51.36 which were at par among themselves. This indicated that all these treatments were found to be showed equal or same efficacy in reducing the stem rot disease.

When grain yield comparision were made, all the treatments were significantly recorded superior yield when compared with control. Highest grain yield was recorded in T1 (*Allium sativum*; 7.145t/ha) followed by T2 (Mustard; 5.882 t/ha). Lowest yield was observed in T8 (Control; 5.354t/ha). Whereas, highest straw yield was recorded in T1 (*Allium sativum*; 8.016t/ha) followed by T3 (Turmeric; 6.48t/ha) and T4 (Eucalyptus oil: 6.43t/ha) which were statistically at par with each other. Lowest yield was observed in T8 (Control;5.7.07t/ha). Hence, among all the treatments tested, T1 (*Allium sativum*), T2 (*Brassica juncea*) and T4 (Eucalyptus oil) were found to be effective in reducing the stem rot disease when compared with other treatments. Results were in agreement with Suleiman and Emua (2009) [7] who studied the use of ginger, aloe, bitter kola and Neem extracts in the control of root rot of cowpea caused by *Pythium aphanidermatum* in the field (*in vivo*). The 4 aqueous plant extracts reduced (to some extent) the incidence and severity of root rot disease of cowpea in the field (*in vivo*). The reduction of infection up to 20% was observed with ginger crude extract.

Chaijuckam and Michael (2010) [3] evaluated essential oils from cinnamon for antagonistic effect against *Rhizoctonia oryzae-sativae*, the cause of aggregate sheath spot of rice. One milliliter of each of four cinnamon oil concentrations (12.5, 37.5, 62.5, or 87.5%) diluted in vegetable oil was applied to the surface of the water in constantly flooded pots. Cinnamon oil suppressed the disease at all concentrations except at 12.5%. However, cinnamon oil at 87.5% was phytotoxic. Cinnamon oil has potential to control aggregate sheath spot but relatively high concentrations were required for disease suppression.

Table 2: *In Vivo* Evaluation of Plant Extracts and Plant Essential Oils against *Sclerotium oryzae*

S. No	Treatments	Stem Rot (Per cent Disease Index)		
		Before Spray	15 Days after 1st spray	15 Days after 2nd spray
T1	Garlic (*Allium sativum*)	12.18 (20.42)	35.62 (36.62)^{c}	39.62 (38.98)^{e}
T2	Mustard (*Brassica juncea*)	14.33 (22.21)	38.25 (38.18)^{bc}	43.38 (41.19)^{de}
T3	Turmeric (*Curcuma longa*)	15.11 (22.87)	43.78 (41.42)^{ab}	47.94 (43.82)^{cd}
T4	Eucalyptus oil (*Eucalyptus globules*)	14.49 (22.36)	38.78 (38.51)^{bc}	45.45 (42.38)^{cde}
T5	Lemon grass oil (*Cymbopogon citratus* L.)	12.36 (20.58)	41.75 (40.25)^{abc}	49.00 (44.42)^{bcd}
T6	Spear mint oil (*Mentha spicata*)	14.04 (21.99)	44.09 (41.60)^{ab}	51.36 (45.78)^{bc}
T7	Mustard oil (*Brassica juncea* L.)	12.78 (20.93)	43.86 (41.47)^{ab}	54.68 (47.69)^{ab}
T8	Control	17.58 (24.69)	46.01 (42.70)^{a}	60.20 (50.89)^{a}
	CD(0.05)	NS	3.651	3.523
	CV	6.792	5.200	4.53

Table 3: *In Vivo* Evaluation of plant extracts and plant essential oils on yield of rice

S.no	Treatments	*Rabi* 2017-18	
		Grain yield (t/ha)	Straw yield (t/ha)
T1	Garlic (*Allium sativum*)	7.145^{a}	8.016^{a}
T2	Mustard (*Brassica juncea*)	5.882^{b}	6.317^{c}
T3	Turmeric (*Curcuma longa*)	6.099^{cd}	6.487^{bc}
T4	Eucalyptus oil (*Eucalyptus globules*)	6.056^{cde}	6.431^{bc}
T5	Lemon grass oil (*Cymbopogon citratus* L.)	5.751^{e}	6.269^{c}
T6	Spear mint oil (*Mentha spicata)*	6.361^{bc}	6.753^{b}
T7	Mustard oil (*Brassica juncea* L.)	6.448^{b}	6.762^{b}
T8	Control	5.354^{f}	5.707^{d}
	CD(0.05)	0.325	0.399
	CV	3.024	2.930

4. Conclusion

Hence, in the present investigation, results revealed that T1 (*Allium sativum*), T2 (*Brassica juncea*) and T4 (Eucalyptus oil) were showed statistically equal efficacy in managing the disease and beneficial.

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