

Original Research Article

A Novel Approach to Manage Bacterial Leaf Blight Disease of Rice through Mushroom Extracts

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ABSTRACT

Rice (*Oryza sativa* L.) is commonly cultivated crop in India as well as over the world. Rice is prone to many diseases, among them bacterial diseases are most destructive which cause significant yield loss. Bacterial leaf blight (BLB) of rice caused by *Xanthomonas oryzae* pv. *oryzae* is emerging as serious threat to worldwide rice production including India & its state of Bihar. Its control is becoming important. Beyond good agronomic practices, growers often rely heavily on chemical fertilizers and pesticides. However, the environmental pollution is caused by excessive use of agrochemicals. Simultaneously, it has hazardous effects on ecological system and human health. Hence, a novel approach to manage this disease through mushroom extracts was made, which is quite safer and suitable to the ecological & environmental systems and is able to protect mankind from health hazards. The main purpose of this research was to establish antimicrobial activities of mushrooms against plant pathogens and utilize mushroom as potential agent to control the plant disease. This innovative environment and eco-friendly approach for management of the disease problem was made during 2012-13 and 2013-14 rice crop seasons. The antimicrobial properties of extracts (ethanolic, hot and cold) of three mushroom species, i.e., *Lentinula edodes* (Shiitake), *Pleurotus florida* (oyster), *Agaricus bisporus* (button) were assessed against *Xanthomonas oryzae* pv. *oryzae*. Efficacy of crude extracts of some botanicals, i.e., *Tagetes erecta* (Marigold), *Azadirachta indica* (Neem), *Zingiber officinale* (Ginger) was also tested against *Xanthomonas oryzae* pv. *oryzae*. It revealed from the results that the maximum zone of inhibition was recorded by the ethanolic extracts of *Lentinula edodes*, followed by cold water extracts of *Pleurotus florida*. Five sprays of ethanolic extract of *Lentinula edodes* gave lowest disease intensity during 2012-13 and 2013-14 crop seasons. Cold water extract of *Pleurotus florida* was found to be the second best extract. The plants sprayed five times with ethanolic extract of *Lentinula edodes* yielded maximum grain yield which was followed by the yield, recorded on the plants sprayed five times with cold water extract of *Pleurotus florida*. Disease Intensity and grain yield obtained from the rice crop treated with different mushroom extracts for control of bacterial leaf blight disease were compared with other control agents, i.e., botanicals and chemical bactericides. Ethanolic extract of *L. edodes* exhibited maximum BLB disease control potential during two consecutive rice crop seasons i.e. in 2012-13 and 2013-14. Rice crops treated with ethanolic extract of *L. edodes* showed lowest disease intensity in comparison with treatments of other control agents. On the basis of the above mentioned results; mushroom extracts may be used for eco-friendly control of BLB disease of rice.

Keywords

Xanthomonas oryzae pv. *oryzae*, Rice (*Oryza sativa*), Bacterial Leaf Blight (BLB), *Lentinula edodes* (Shiitake), Ethanolic extracts

Introduction

Rice (*Oryza sativa* L.) is the most staple and leading cereal crops in the world. Bacterial leaf blight (BLB) of rice, caused by *Xanthomonas oryzae* pv. *oryzae* (Ishiyama) (Swings *et al.*, 1990), is the major limiting factor in rice production. Traditionally, the plant diseases are controlled through chemical fungicides, bactericides etc. But, the chemical pesticides has its toxic residual effects on plants, soil and ultimately on human health. It contributes in environmental pollution and disturbs the balanced ecological system.

Keeping in view the seriousness of the problem, the need for management of plant disease through biological agents has been deeply considered. Mushrooms contain high medicinal values and hence are capable in controlling human and plant diseases.

Materials and Methods

While studying antimicrobial properties of Mushroom extracts; hot, cold and ethanolic solvents of fruiting bodies extract of three mushroom species, i.e. *Agaricus bisporus*, *Pleurotus florida* and *Lentinula edodes* were assessed against *Xanthomonas oryzae* pv *oryzae* by disk diffusion method. Efficacies of crude extracts of fruiting bodies of three mushroom species were compared along with hot, cold and ethanolic solvent of extract of *Azadirachta indica*, *Tagetes erecta* and *Zingiber officinale*.

To evaluate the effect of spray schedules of mushrooms and plant extracts on disease intensity and grain yield of rice, the experiment was carried out in the potted rice plants [variety- 'Nata Mahsuri (MTU 7029)'/ Swarna] under poly house condition during the 2012-13 and 2013-14 rice crop season. Each extract was sprayed (1:10

dilution) under five different spray schedules. The plants were inoculated with bacterial suspension of *Xanthomonas oryzae* pv. *oryzae* by the leaf clipping inoculation method. Effect of different dates of sowing & corresponding transplanting of rice and weather data corresponding to disease development were also recorded and correlated with disease development.

Results and Discussion

While testing the effect of crude extracts of different mushrooms and plants on the growth of *Xanthomonas oryzae* pv *oryzae* *in vitro*, the maximum zone of inhibition was recorded by the ethanolic extracts of *Lentinula edodes* [20.5 mm], followed by cold water extracts of *Pleurotus florida* [17.3 mm]. The third highest zone of inhibition recorded was 14.3 mm given by ethanolic extracts of *Agaricus bisporus* as shown in figure 2.

Five sprays of ethanolic extract of *Lentinula edodes* gave lowest disease intensity during 2012-13 and 2013-14 crop seasons. Cold water extract of *Pleurotus florida* was second best extract and its five sprays showed superiority over rest of sprays during both the years of experimentations. Spraying five times with ethanolic extract of *Agaricus bisporus* was third best extract in controlling disease intensities in both the years of experimentation. The plants sprayed five times with ethanolic extract of *Lentinula edodes* yielded maximum grain yield which was followed by the yield, recorded on the plants sprayed five times with cold water extract of *Pleurotus florida*. Disease intensity and grain yield obtained from the rice crop treated with different mushroom extracts for control of bacterial leaf blight disease were compared with other control agents, i.e., botanicals and chemical bactericides.

Fig.1 Graphical representation of effect of crude extracts of different mushrooms and plant parts on the growth of *Xanthomonas oryzae* pv *oryzae* in vitro

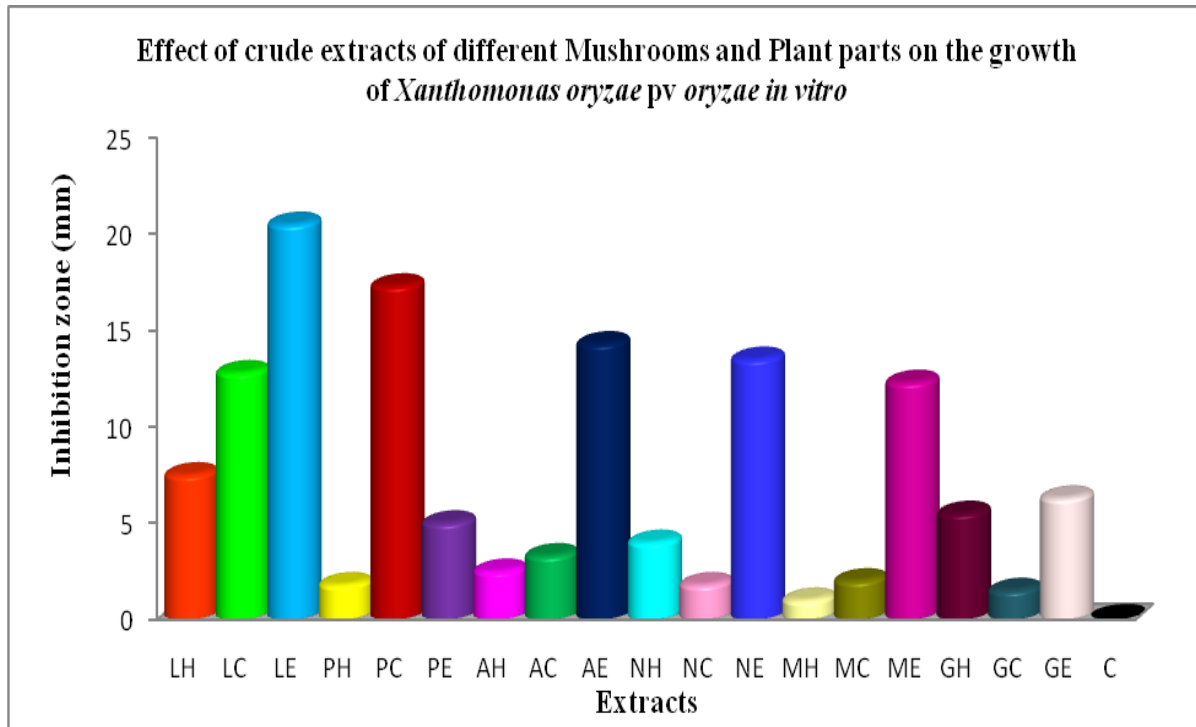
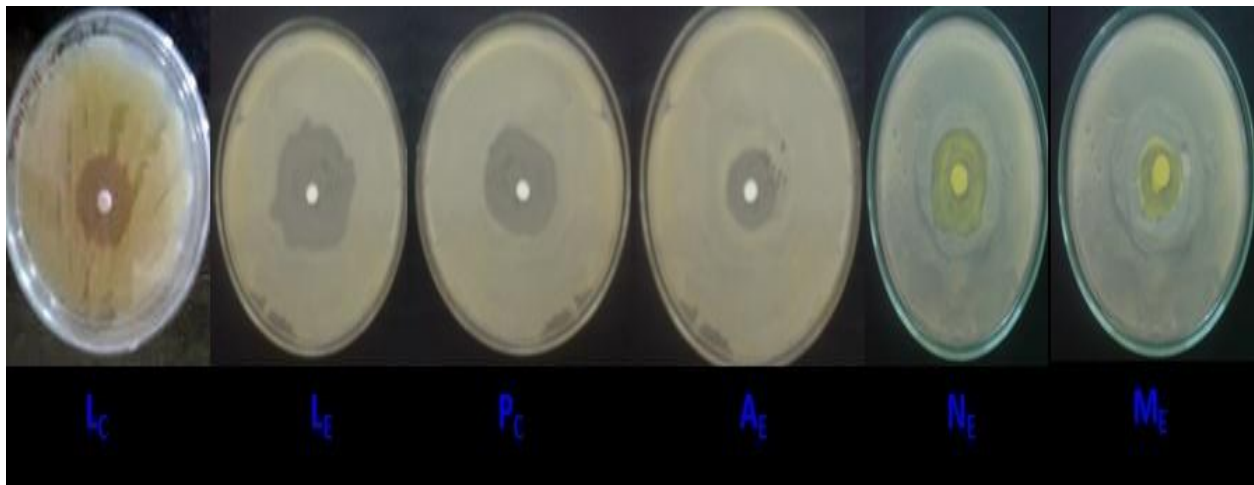


Fig.2 Effect of crude extracts of different mushrooms and plant parts on the growth of *Xanthomonas oryzae* pv *oryzae* in vitro



Note: Hot water extract of *Lentinula edodes* (L_H), Cold water extract of *Lentinula edodes* (L_C), Ethanolic extract of *Lentinula edodes* (L_E), Hot water extract of *Pleurotus florida* (P_H), Cold water extract of *Pleurotus florida* (P_C), Ethanolic extract of *Pleurotus florida* (P_E), Hot water extract of *Agaricus bisporus* (A_H), Cold water extract of *Agaricus bisporus* (A_C), Ethanolic extract of *Agaricus bisporus* (A_E), Hot water extract of *Azadirachta indica* (N_H), Cold water extract of *Azadirachta indica* (N_C), Ethanolic extract of *Azadirachta indica* (N_E), Hot water extract of *Tagetes erecta* (M_H), Cold water extract of *Tagetes erecta* (M_C), Ethanolic extract of *Tagetes erecta* (M_E), Hot water extract of *Zingiber officinale* (G_H), Cold water extract of *Zingiber officinale* (G_C), Ethanolic extract of *Zingiber officinale* (G_E), Control without any extract (C)

Fig.3 Graphical representation of Effect of spray schedules of mushroom and plant extracts on disease intensity and grain yield of rice in 2012-13

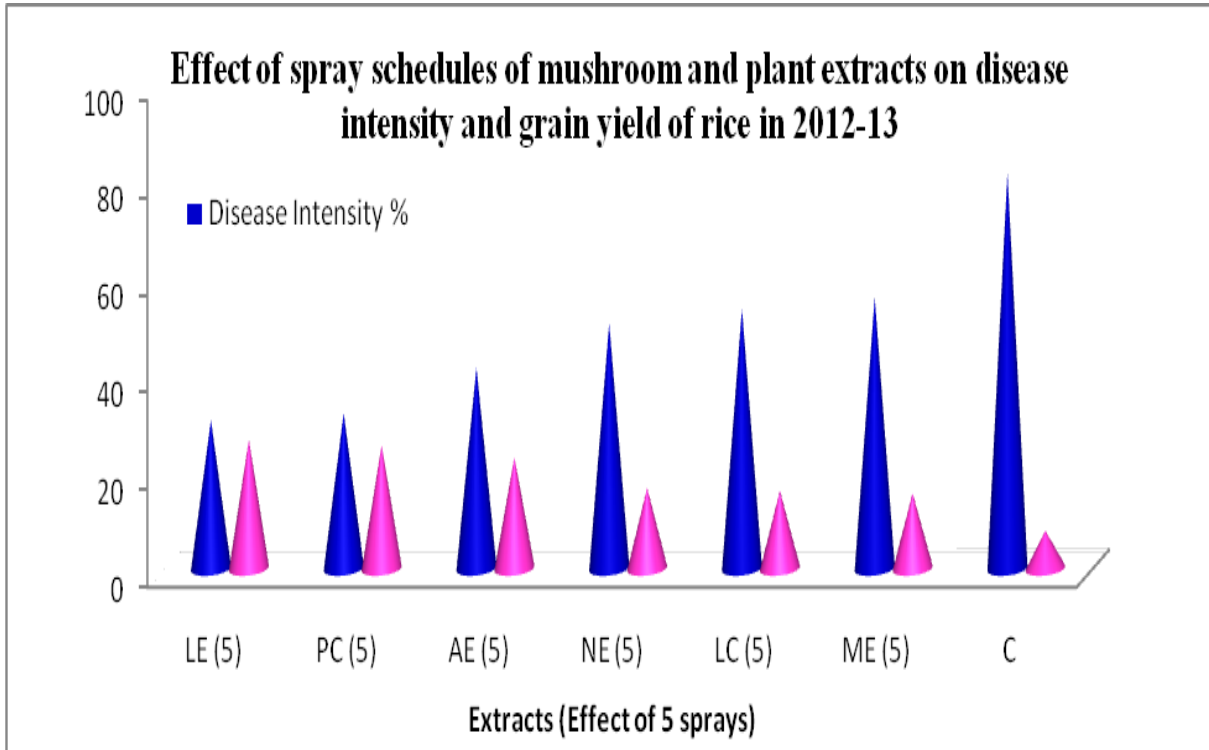
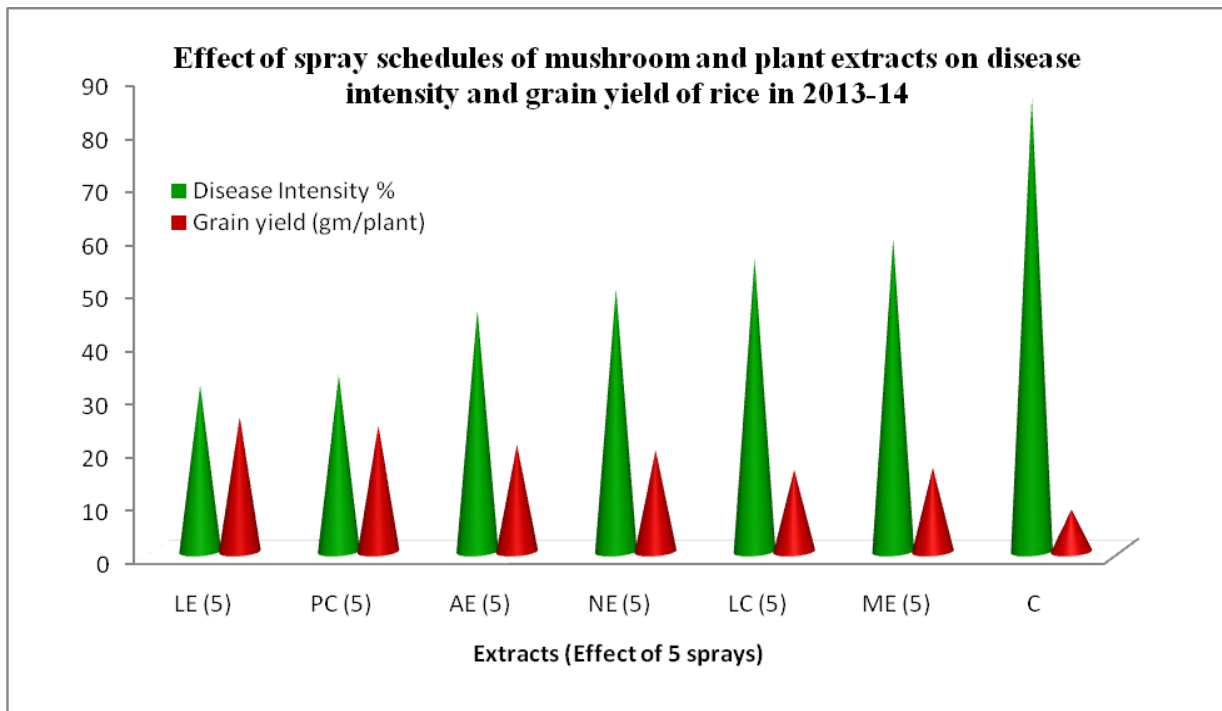


Fig.4 Graphical representation of Effect of spray schedules of mushroom and plant extracts on disease intensity and grain yield of rice in 2013-14



Rice crops treated with ethanolic extract of *L. edodes* showed lowest disease intensity in comparison with treatments of other control agents.

Ethanolic extract of *L. edodes* showed highest yield, in the crops produced during two consecutive rice crop seasons i.e. in 2012-13 and 2013-14, which proved to be the most effective treatment, as well as, an eco-friendly and cost effective approach. *L. edodes* contains – Lentinan, Lentithionine and oxalic acid; effective for control of BLB disease of rice (Hirasawa *et al.*, 1999).

The facts and figures of this study authenticated that the mushroom extract contains sufficient potential to manage the BLB disease of rice. This practice is absolutely an environment-friendly & eco-friendly approach which ultimately safeguards the human health and natural flora & fauna.

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