Disease Control of Rice Blast Caused by Pyricularia Oryzae Cavara Using Novel Chitosan-based Agronanofungicides

Authors : Abdulaziz Bashir Kutawa, Khairulmazmi Ahmad, Mohd Zobir Hussein, Asgar Ali, Mohd Aswad Abdul Wahab, Amara Rafi, Mahesh Tiran Gunasena, Muhammad Ziaur Rahman, Md. Imam Hossain, Syazwan Afif Mohd Zobir

Abstract : Rice is a cereal crop and belongs to the family Poaceae, it was domesticated in southern China and North-Eastern India around 8000 years ago, and it's the staple nourishment for over half of the total world's population. Rice production worldwide is affected by different abiotic and biotic stresses. Diseases are important challenges for the production of rice, among all the diseases in rice plants, the most severe and common disease is the rice blast. Worldwide, it is one of the most damaging diseases affecting rice cultivation, the disease is caused by the non-obligate filamentous ascomycete fungus called Magnaporthe grisae or Pyricularia oryzae Cav. Nanotechnology is a new idea to improve agriculture by combating the diseases of plants, as nanoparticles were found to possess an inhibitory effect on different species of fungi. This work aimed to develop and determine the efficacy of agronanofungicides, and commercial fungicides (in-vitro and in-vivo). The agronanofungicides were developed using ionic gelation methods. In-vitro antifungal activity of the synthesized agronanofungicides was evaluated against P. oryzae using the poisoned medium technique. The potato dextrose agar (PDA) was amended in several concentrations; 0.001, 0.005, 0.01, 0.025, 0.05, 0.1, 0.15, 0.20, 0.25, 0.30, and 0.35 ppm for the agronanofungicides. Medium with the only solvent served as a control. Mycelial growth was recorded every day, and the percentage inhibition of radial growth (PIRG) was also calculated. Based on the results of the zone of inhibition, the chitosan-hexaconazole agronanofungicide (2g/mL) was the most effective fungicide to inhibit the growth of the fungus with 100% inhibition at 0.2, 0.25, 0.30, and 0.35 ppm, respectively. The least were found to be propiconazole and basamid fungicides with 100% inhibition only at 100 ppm. In terms of the glasshouse results, the chitosan-hexaconazole-dazomet agronanofungicide (CHDEN) treatment (2.5g/L) was found to be the most effective fungicide to reduce the intensity of the disease with a disease severity index (DSI) of 19.80%, protection index (PI) of 82.26%, lesion length of 1.63cm, disease reduction (DR) of 80.20%, and AUDPC (390.60 Unit2). The least effective fungicide was found to be ANV with a disease severity index (45.60%), protection index (45.24%), lesion length (3.83 cm), disease reduction (54.40%), and AUDPC (1205.75 Unit2). The negative control did not show any symptoms during the glasshouse assay, while the untreated control treatment exhibited severe symptoms of the disease with a DSI value of 64.38%, lesion length of 5.20 cm, and AUDPC value of 2201.85 Unit2, respectively. The treatments of agronanofungicides have enhanced the yield significantly with CHDEN having 239.00 while the healthy control had 113.67 for the number of grains per panicle. The use of CHEN and CHDEN will help immensely in reducing the severity of rice blast in the fields, and this will increase the yield and profit of the farmers that produced rice.