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Deep learning approach to predict Brown Plant Hopper incidence on the rice plant with climate change

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Brown Plant Hopper (BPH) incidence on the rice plant is a huge problem in the agricultural field. Damage caused by the BPH is very high in rice cultivation and has highly influenced farmers who cultivate rice. Minimum and maximum temperature, morning and evening relative humidity, rainfall, sunshine hours and the wind velocity are the climatic factors that influence the BPH incidence. This study was carried out to identify the relationship between BPH incidences on rice plant with climatic factors and to build a suitable model to predict BPH incidence on the rice plant. A dataset collected from the rice research and development institute in Batalagoda, Sri Lanka for the period 1st January, 2014 to 31st of May, 2020 was considered for this study. In BPH data, there are numerous missing values and thus, missing value imputation techniques were followed to fill the missing observations. Linear interpolation, backward forecasting, using average of two seasons and the specified packages in R software; namely, mice, amelia and missForest were used as the missing value imputation techniques. Among them using average of two seasons in the rice cultivation, 'Yala' and 'Maha' was the best method for missing value imputations. To identify the relationship between BPH and climatic variables, two machine learning techniques Feed-Forward Neural Network (FFNN) and Recurrent Neural Network (RNN) were employed. By adjusting parameters in the two neural network models, FFNN model with three hidden layers of hidden neurons 1,1,3 and RNN model with two hidden layers of hidden neurons 1,3 were considered as better models. Comparing the aforementioned two models, RNN model exhibits the least mean squared error and mean absolute error which were 0.4696 and 0.4285, respectively. This study is a good approach to the experts who are interested in the agricultural fields to do more studies in the pest incidences on the rice plant using the advanced techniques. These findings may also be helpful for the agricultural sector to improve their traditional methods to an advanced level with the technology.

Keywords: Brown Plant Hopper, Feed-Forward Neural Network, Recurrent Neural Network

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