CTRF
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RESEARCH FOUNDATION

LA FONDATION CANADIENNE DE RECHERCHE EN GAZON

July 5, 2022

For immediate release:

Interim report - July 2022
'Understanding and predicting pesticide use on golf courses using deep machine learning'

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<u>Abstract</u>
Golf course maintenance requires the use of several inputs, such as pesticides and fertilizers that can be harmful to human health or the environment. Understanding the factors associated with pesticide use on golf courses may help golf-course managers reduce their reliance on these products. In this study, we used a database of about 14,000 pesticide applications in the province of Québec, Canada, to develop a novel hybrid machine learning approach to predict pesticide use on golf courses.

We created this proposed model, called RF-SVM-GOA, by coupling a support vector machine (SVM) with random forest (RF) and the grasshopper optimization algorithm (GOA). We applied RF to handle the wide range of datasets and GOA to find the optimal SVM settings. We considered five different dependent variables—region, golf course ID, number of holes, year, and treated area—as input variables.

The experimental results confirmed that the developed hybrid RF-SVM-GOA approach was able to estimate the active ingredient total (AIT) with a high level of accuracy (R = 0.99; MAE = 0.84; RMSE = 0.84; NRMSE = 0.04). We compared the results produced by the developed RF-SVM-GOA model with those of four tree-based techniques including M5P, random tree, reduced error pruning tree (REP tree), and RF, as well as with those of two non-tree-based techniques including the generalized

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structure of group method of data handling (GSGMDH) and evolutionary polynomial regression (EPR). The computational results showed that the accuracy of the proposed RF-SVM-GOA approach was higher, outperforming the other methods. We analyzed sensitivity to find the most effective variables in AIT forecasting. The results indicated that the treated area is the most effective variable in AIT forecasting. The results of the current study provide a method for increasing the sustainability of golf course management.

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The Canadian Turfgrass Research Foundation (CTRF) is a registered charity that raises funds for turfgrass research projects aimed at advancing education and scientific knowledge associated with the safe, recreational and functional use of turfgrass.

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