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Development of predictive models using Data Mining techniques to detect borer infestation (Diatraea saccharalis) in sugarcane culture.

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Abstract
Borer infestation (Diatraea saccharalis) is one of the main concerns in the sugarcane crop because it affects productivity directly and negatively. In order to find alternatives that minimize these damages, the objective of this work is to develop predictive models using data mining tools to predict the infestation of the borer in the sugarcane crop.

Key words:
Pest modeling, data mining, thermal time.

Introduction

The sugarcane crop in Brazil is the target of infestation by Diatraea saccharalis, also known as borer. The borer, in its larval phase, penetrates the stem, leading to the opening of numerous galleries. Such galleries reduce stem mass, provide lodging and can cause death of the buds, harming production and reducing productivity up to 20%. In addition, the holes made by the borer are convenient for secondary pests, since they facilitate the entry of these pathogens that accentuate the losses of the processing of the cane with the microbiological contamination.

To hold back the infestation, practices such as chemical and/or biological control are utilized, increasing the cost of production, reducing producer's and plant's margins, and not always being sustainable.

Control could be more effective if it were possible to anticipate the areas in which the conditions are favorable to the appearance of the pest. Data mining techniques can contribute to the solution of the mentioned problem, since they make it possible to extract information from data sets. Thus, the objective of this work was to develop predictive models of borer infestation rates (Diatraea saccharalis) in sugarcane cultivation using regression trees.

Results and Discussion

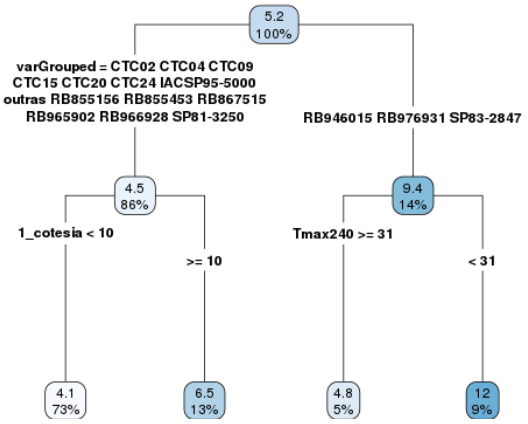
For this, knowledge discovery procedures were performed in a dataset from a plant in the state of São Paulo using regression trees. The initial attributes available in the plant data set were reworked to facilitate analysis.

Preliminary results indicated that meteorological conditions and properties such as variety and number of cuts are the factors most related to the index of infestation.

Image 1 is an example of tree resulting from rpart algorithm. The first level is called the root of the tree, the last levels are called leaves. Lighter shades are lower percentages of brocaded internodes, darker shades are higher percentages and in the line that connects the blocks are the attributes used in the prediction with their respective values.

It was observed that of the 46 initial varieties, 3 were more susceptible to infestation: SP83-2847, RB946015, RB976931. The common feature among these is high productivity. According to Image 1, if the number of individuals of cotesia is less than 10 cups, the percentage of brocaded internodes is smaller; If the number of individuals is greater than or equal to 10 cups, the percentage of brocaded internodes is also higher. A plausible justification for this result is that when the infestation is relatively low, fewer individuals of cotesia are able to control it. When the infestation is already at higher levels, even if more individuals of cotesia are applied, they are not able to contain and / or reduce the population of the borer.

Image 1. Regression tree with better metrics among the 60 models studied.



Conclusions

It is concluded that, although the attributes of thermal time are not inserted in the final models, the frequent presence of elevated temperatures and precipitations indicates that the meteorological attributes are determinant for the rate of infestation. The meteorological attributes of periods of 4 months prior to harvesting were relevant.

It is also verified that the critical situations for borer infestation occurs in SP83-2847, RB946015 and RB976931 plants and for sugarcane in its first cycle, thus prioritizing infestation surveys and attempting to handle management in fields with these characteristics.

It was observed that the biological control of cotesia is only effective when practiced in levels of infestation of borer still controllable. Once the rate of infestation has been extrapolated, even if more cotesia are applied, it will not be possible to reduce the infestation. The study found that with 10 cups of cotesia or more, the control of the infestation is no longer effective.

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