Forecasting of root damage, plant lodging and yield loss caused by western corn root worm larval feeding based on larval population density

Vorhersage von Wurzelschäden, Lagerschäden und Ertragsverlusten durch Larvenfraß des Westlichen Maiswurzelbohrers auf der Grundlage der Larvenpopulationsdichte

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Various authors in the USA investigated the forecasting of root damage, plant lodging and yield loss caused by western corn rootworm (WCR) larvae. Depending on the year, WCR larvae are causing damages in Croatia and in Central Europe at different intensity. The total damage is the result of various factors whereof the most important are the WCR larval population and the weather conditions within specific years and at particular localities. For better understanding how larval population and weather conditions are influencing the damage, investigations under conditions with severe infestations of WCR should be carried out. Overall increase of WCR population in Croatia and in Central Europe enabled us to conduct studies under conditions of natural WCR infestation. The aim of the research was to develop a model for damage forecast based on established WCR larval population densities. Therefore we analysed the relationship between WCR larval population established at the time of maximal larval feeding and subsequent root damage, plant lodging and yield loss.

Experiments were conducted in three regions of Croatia during three field seasons (2007-2009). Within each season five continuous maize fields in each region (i.e., 15 fields per year) were involved. The WCR larval population was established in June at the Julian day (JD) 170 (in 2007), 163 (in 2008) and 167 (in 2009). Ten plants in each of four randomly selected rows in the field were dug (i.e., 40 plants per field) to assess the average number of WCR larvae per plant. By using the same methodology 40 roots per field were dug and scores on the Node Injury Scale (NIS, 0-3) were recorded at JD 203 (in 2007 and in 2009) and JD 206 (in 2008). Plant lodging was estimated at the JD 261 (in 2007), 267 (in 2008) and 265 (in 2009). Lodging was measured using 100 plants in 5 randomly selected rows in each field (i.e., 500 plants per field). The plants were grouped as follows: upright, partially and fully lodged. In each field from each grouping, three samples containing ten plants were harvested. The average yield was determined for each category and based on the ratio of each category in a particular field the average yield was calculated. Yield loss was calculated by comparing obtained yields with the yields of upright plants in each field. All relationships were assessed by using a linear regression model which involved interaction with the year as an indicator of weather conditions. Significant interactions between WCR larval population and year for forecasting root damage rate were determined. The year resulting with the steepest slope was chosen for establishing damage threshold. The infestation with 1.08 WCR larvae per plant predicts an average of 0.75 node injury score. Significant interactions between the WCR larval population and year for the relationship between WCR larval population and partially and fully lodged plants were not determined. Fully lodged plants are not suitable to forecast damage according to WCR larval population. An average of 10.9% of yield reduction could be forecasted if one WCR larvae per plant was established. Weather conditions did not affect the relationship significantly. A significant interaction between the year and upright plants in the field could be determined if the root damage rate was used as a forecast tool. An average of10% of partially lodged and an average of 10% fully lodged plants could be forecasted if the root damage rate of 0.62 and 2.14 were established, respectively. Weather had low impact on the relationship between root damage rate and yield; different years had similar weather conditions. An average of 17.5% of yield reduction could be forecasted if a root damage rate of 0.75 was established. Results from this study are important for better understanding the relationship between the final damage caused by WCR larval population and weather conditions. Therefore results could be used for creating guidelines for an integrated maize production.