EFITA 2015 June 29 - July 2 Poznań

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Data Quality and Information Quality

- the Case of the Negative Prognosis Plant Protection Model

Foreword

As of 1 Jan. 2014 the EU countries were obliged to enforce integrated plant protection (IPP). To implement the IPP properly a thorough analysis of cultivation status of the field has to be conducted and a great number of factors have to be taken into account. This is one of the reasons that at present more and more universally decision support systems (DSS) are being used in farm practice to facilitate decision making.

Three DSS types can be enumerated for determining the need for protection treatments: symptom-based, meteorological and combined.

Symptom-based systems determine the need for treatments on the basis of assessment of disease symptoms or damage of plants.

Meteorological systems use mathematical models to determine the pest developmental stage depending on weather data.

Combined systems are a combination of the two.

In meteorological and combined systems weather data quality plays the fundamental role in the correctness of generated recommendations. The knowledge about potential effects of inaccurate weather data and data verification procedures is of utmost importance when using meteorological plant protection models in practice.

Negative Prognosis model

Crop: Potato **Authors: Ullrich J., Schrodter H.**
(Germany 1966)
Disease: Late Blight **Input: hour temperature, relative**
humidity
Pathogen: ***Phytophthora infestans***

Used to predict the date of the first treatment

Source: UC IPM Online, University of California

Negative Prognosis is made available at Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG-PIB)
at: www.ipm.iung.pulawy.pl

Model parameters (validated for Poland by Kapsa):
- high relative humidity threshold: 87%
- first treatment recommended when accumulated risk value > 130 and daily risk value > 7

Material and Methods

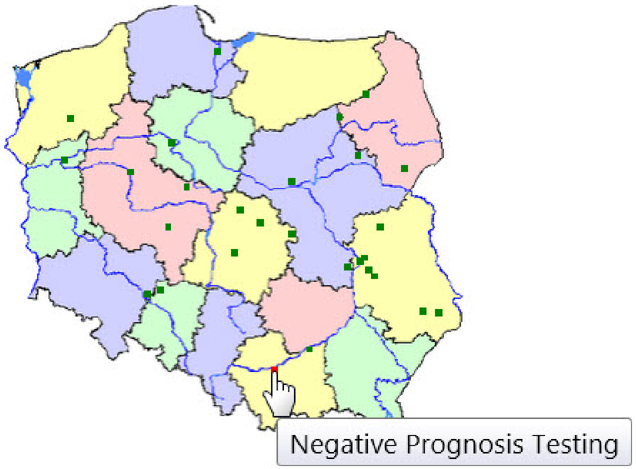

Figure 1. Negative Prognosis model – for simulation new station was added (Negative Prognosis Testing)

1. Analysis of the model code was conducted in order to determine the characteristics of the output depending on the input
2. To the database with weather data a new station was added: Negative Prognosis Testing (fig.1)
3. Simulation experiments were conducted in order to corroborate the findings determined in the analysis of the code – weather data were prepared for each run of the model

Results 1

Conditions for high daily risk value:

- temperatures 10-12 °C or 14-16 °C, relative humidity (RH) above threshold 87% for at least 4 consecutive hours,
- temperatures 12-14 °C or 18-24 °C, relative humidity above threshold 87% for at least 10 consecutive hours.

The decisive weather data quality factors for Negative Prognosis model are:

- precision of measurements of RH near value of 87%,
- precision of measurements of temperature near values of: 10, 12, 14, 16, 18 and 24 °C.

The results from a query of the weather database of 27 agrometeorological stations in 2014 in the period from potato emergence (May 15) to the end of June showed that the number of hours of relative humidity close to threshold of 87% (from above) were from 10 to 138 (table 1).

Results 2

Table 1. Numbers of hours of relative humidity close to threshold 87%, period from potato emergence (May 15) to the end of June (from 27 stations)

	RH 87%-90%	RH 87%-89%	RH 87%-88%
Min	18	18	10
Max	138	88	52
Avg	81	53	27

Nieróbca (unpublished materials) found that the HR measurement error may be as high as 5% (typical measurement tolerance range is ±3%).
To find a possible influence of measurement error on Negative Prognosis results the RH values above threshold of 87% (consistently with tab. 1) were sequentially changed to 86.99%, to create a simulated error of 1%, 2% and 3%. The model was run each time with changed input.

The results of the runs are shown in table 2.

Results 3

Table 2. Recommended date of first treatment as influenced by simulated RH measurement error of 1%, 2% and 3% (lowest and highest number of measurements proximate to threshold, May 15 – June 30)

Number of hours	Original value	Error 1%	Error 2%	Error 3%
10, 22 and 35 respectively	June 4	June 4	June 4	June 12
51, 88 and 137 respectively	June 16	June 16	June 27	June 27

Conclusion

From the simulation results it follows that even a small error of 2-3% (within the range of measurement tolerance) may cause a serious error in the date of the first treatment. The delay established in the simulation experiment was 8-11 days. These results correlate well with the results achieved by Nieróbca, who compared a new RH sensor with worn-out one and showed the delay can be as many as 17 days.