Weather instruments calibration as influence on diseases prediction in viticulture

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Introduction

In-situ calibration of weather stations installed in agricultural sites is usually performed by comparison. This procedure was metrologically evaluated and showed relevant weak points. There is a need for testing various types of sensors, their calibration, and to evaluate the measurement uncertainty related the meteorological quantities in order to improve vineyard disease predictions and reduce the use of chemicals in agriculture.

Moreover, vineyards or other agricultural sites are often positioned on slopes, close to the forests where the canopy influences the weather conditions in the vicinity. This forces a non-ideal position of weather instruments and the outcome data do not take into account the measurement uncertainty related the slope, the proximity of trees, and intensity of solar radiation.

The proposed research aims to achieve a metrological approach applied to agrometeorological studies and goes to implement of traceability in weather measurements, to investigate on the effect on meteorological measurements due to the automatic weather stations (AWS) positioning in agricultural sites, to disseminate by researchers of calibration methods and procedures to agriculture operators.

Fig. 1 – VA Automatic Weather Station in conformity with WMO recommendations

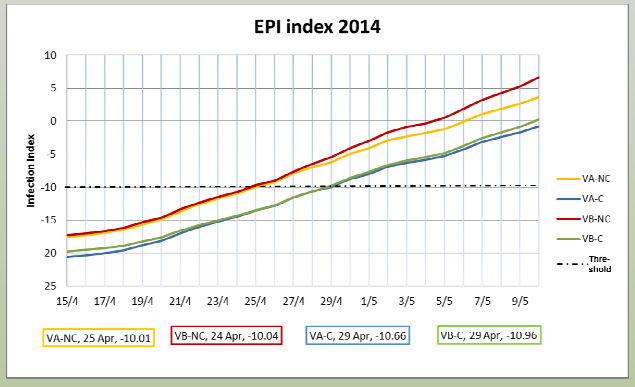

Fig. 2 – EPI index focused on period in which is highly recommended make a treatment. The boxes explained the day in which EPI value reach the critic value

Materials and Methods

Two AWSs (Fig. 1) have been installed in a vineyard placed in Monferrato, both composed by air temperature (T), relative humidity (RH) and solar radiation (Rad) sensors. The first one (VA) has been placed in conform to WMO recommendations (WMO, 2008), the second in proximity of trees that influence weather measurements (VB).

The T and RH sensors have been calibrated using the "EDIE" facility (Lopardo *et al.*, 2014, Fig. 4), developed under the European ENV07 MeteoMet project (Merlone *et al*., 2015).

Four simulations by employing EPI epidemiological forecasting model, improved as described in Sanna *et al.* (2014), have been performed: data from VA with and without inclusion of measurement uncertainties in the input values (VA-C and VA-NC, respectively); and data from VB with and without inclusion of uncertainties (VB-C and VB-NC, respectively).

Results and Discussion

Average data collected hourly from 2013 to 2014 of the same AWS (calibrated and not calibrated) and between the two AWS are always statistically different (Kruskal-Wallis).

It can be appreciated a difference between the information recorded by the two calibrated AWSs. The difference is also confirmed by the high coefficient of variation of their ratio.

Figure 3 shows how the Rad measured in VB is often lower than that measured in VA, especially at the higher solar radiation values.

The four simulations of pathogen infection shown different results. The forecasting of VA-NC and VB-C are overlapped around of the estimate period of germination, while VA-C postpones the forecast and VB-NC anticipate of about three and six days, respectively.

Although the comparison between data calibrated and not calibrated brings forward the forecasting models of only three days, this fact must be added to the positioning of the AWSs, which amplifies the date up to a week (Figure 2).

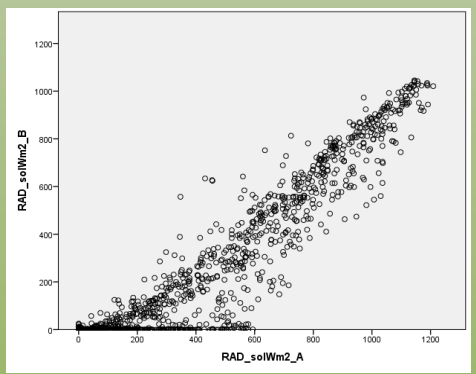

Fig. 3 – Relation between the Rad measured in VA and VB

Conclusions

The inclusion of calibration and positioning's contributions affects the disease prediction up to a week, these are important factors in agrometeorology, although further in-depth studies are needed in this field focus to define a *reference grade sensor* for agricultural sector. Measurements should be based on fully documented traceability and forecasting models should include measurement uncertainties in their input values to improve output data accuracy.

Earth Dynamics Investigation Experiment

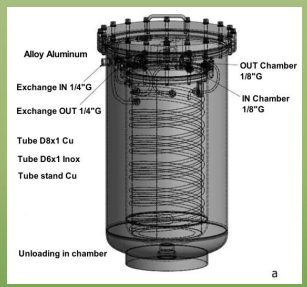

Fig. 4 – Calibration chamber "EDIE" Earth Dynamics Investigation Experiment

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