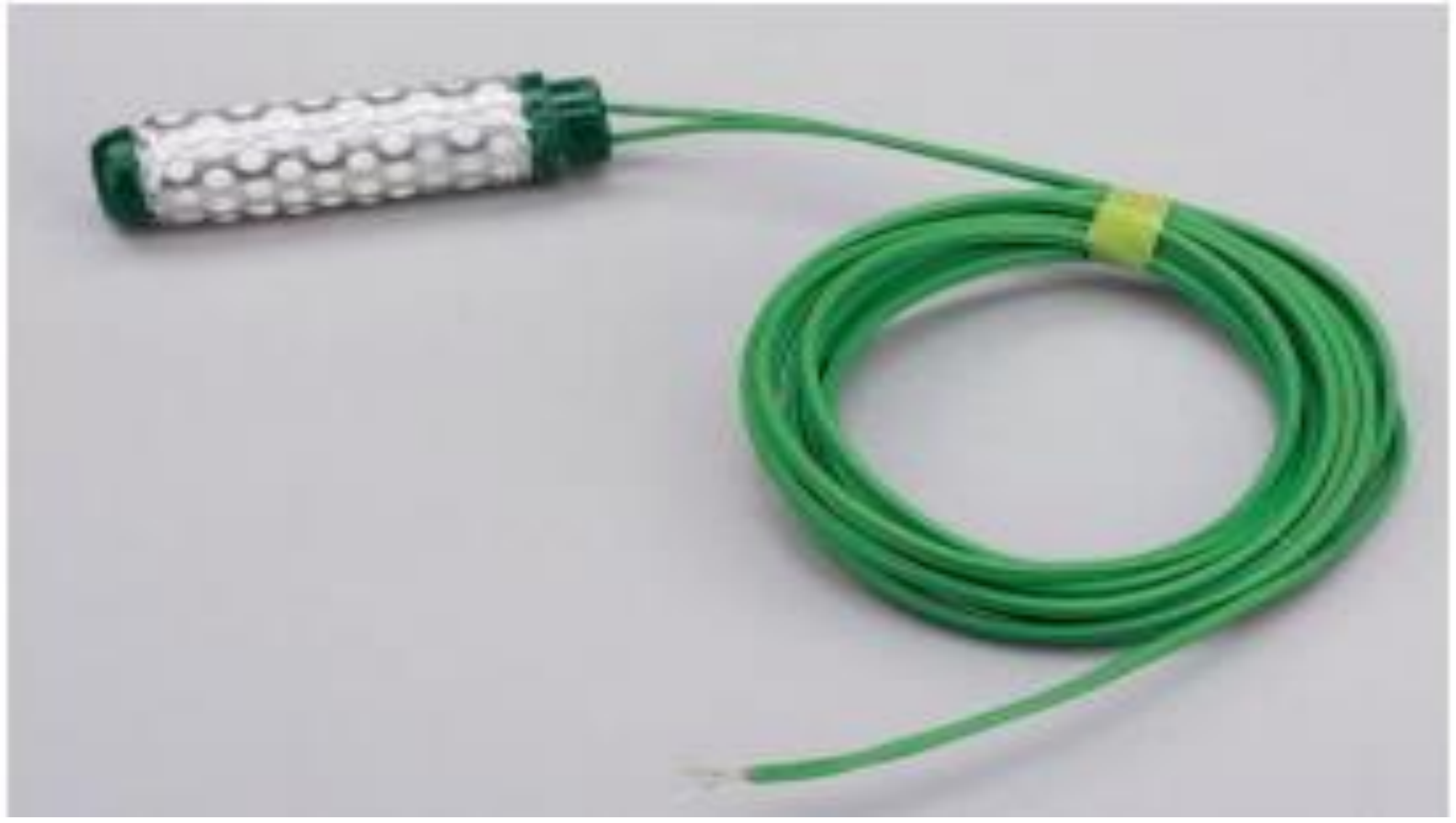
KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

CALIBRATION PROCESS OF SOIL MOISTURE MEASUREMENTS

Student -Roberta Dranseikaite,
Supervizot Assoc.prof. Dr. Vilda Grybauskiene

Kaunas Forestry and Environmental Engineering University of Applied Sciences. Kaunas. Lithuania



XIII Международная научно-практическая конференция молодых ученых 2021

KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

PLANT GROWTH PRODUCTIVITY DEPENDS ON

Local soil properties

Climate conditions

Carbon dioxide level in atmosphere

Genetic properties of plant species

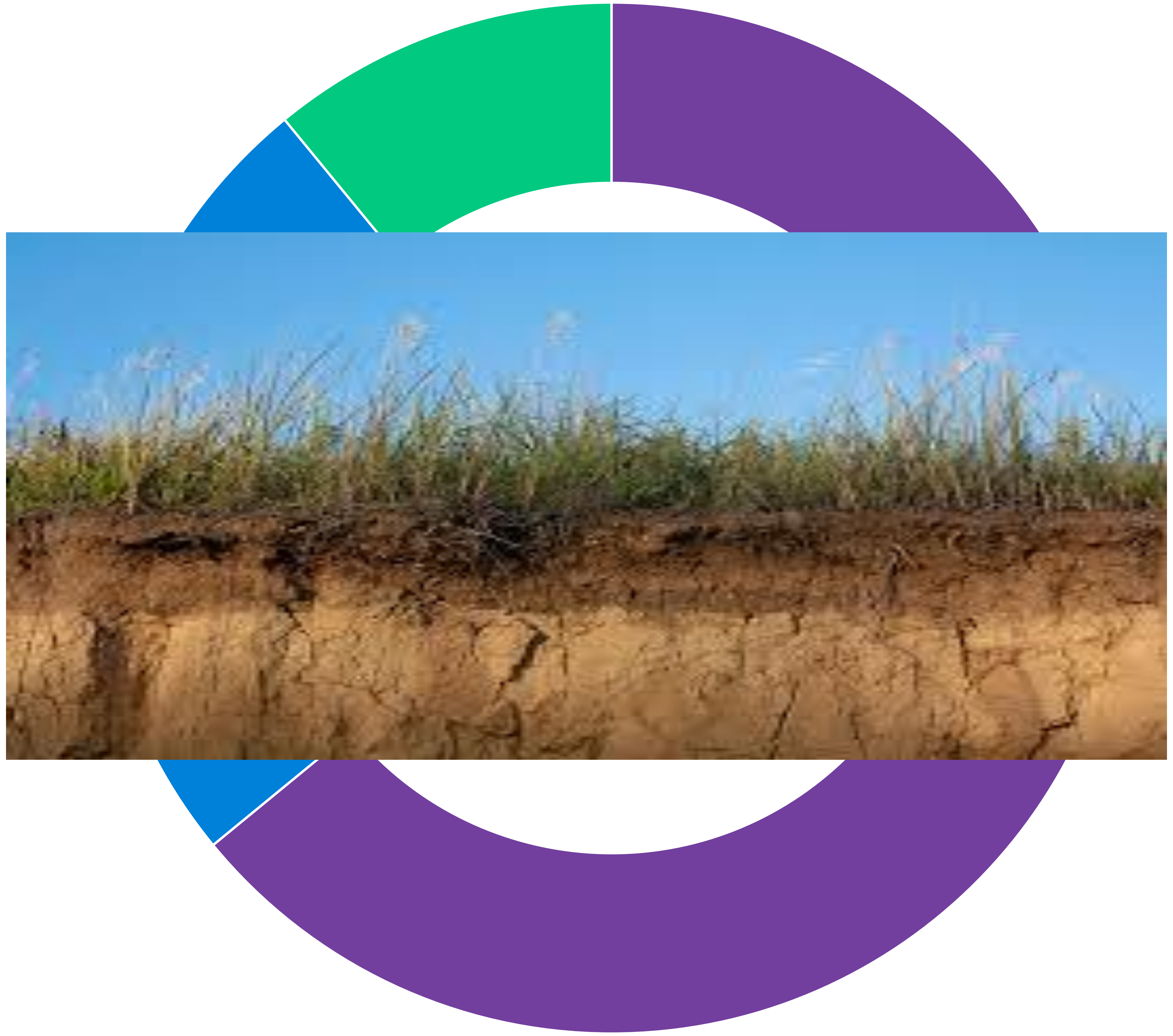
Plant growth phase

Pests, diseases, etc

KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

Literature overview

Integration in European environment monitoring system by applying the Standardized Precipitation Index to identify not only meteorological droughts, but also agricultural droughts is very important for Lithuanian region. The World Meteorological Organization (WMO) recommends applying SPI to identify a meteorological drought; therefore, alignment of long-term monitoring data and rating scale adjustment is necessary in order to adapt it to our region and use it for identification of agrometeorological droughts in Lithuania [4]..



Annual precipitation deviation from the mean value (in long-term period) is up to 40 % and monthly deviations achieve 60 %. Such high irregularity has very adverse effect on agriculture [1]. Droughts in Lithuania occur periodically and became more frequent during the last decades; droughts of different intensity and duration occur almost every year [2]. Within the period 1961-1995, disastrous droughts of local significance recurred approximately every 9 years [3].

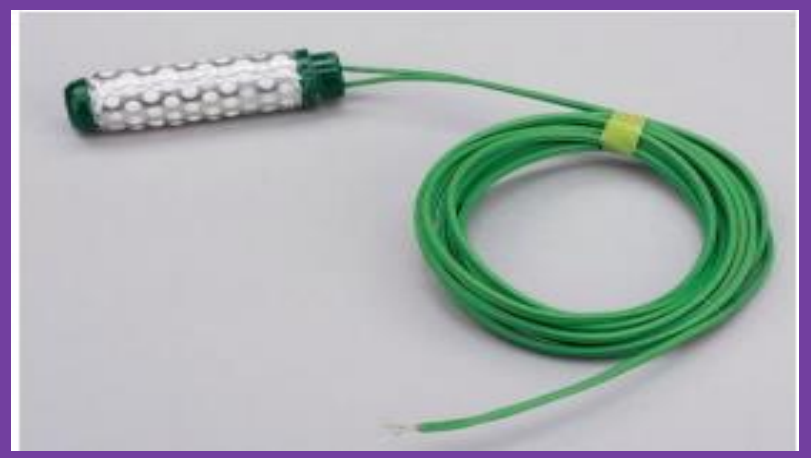
The Aim of the work

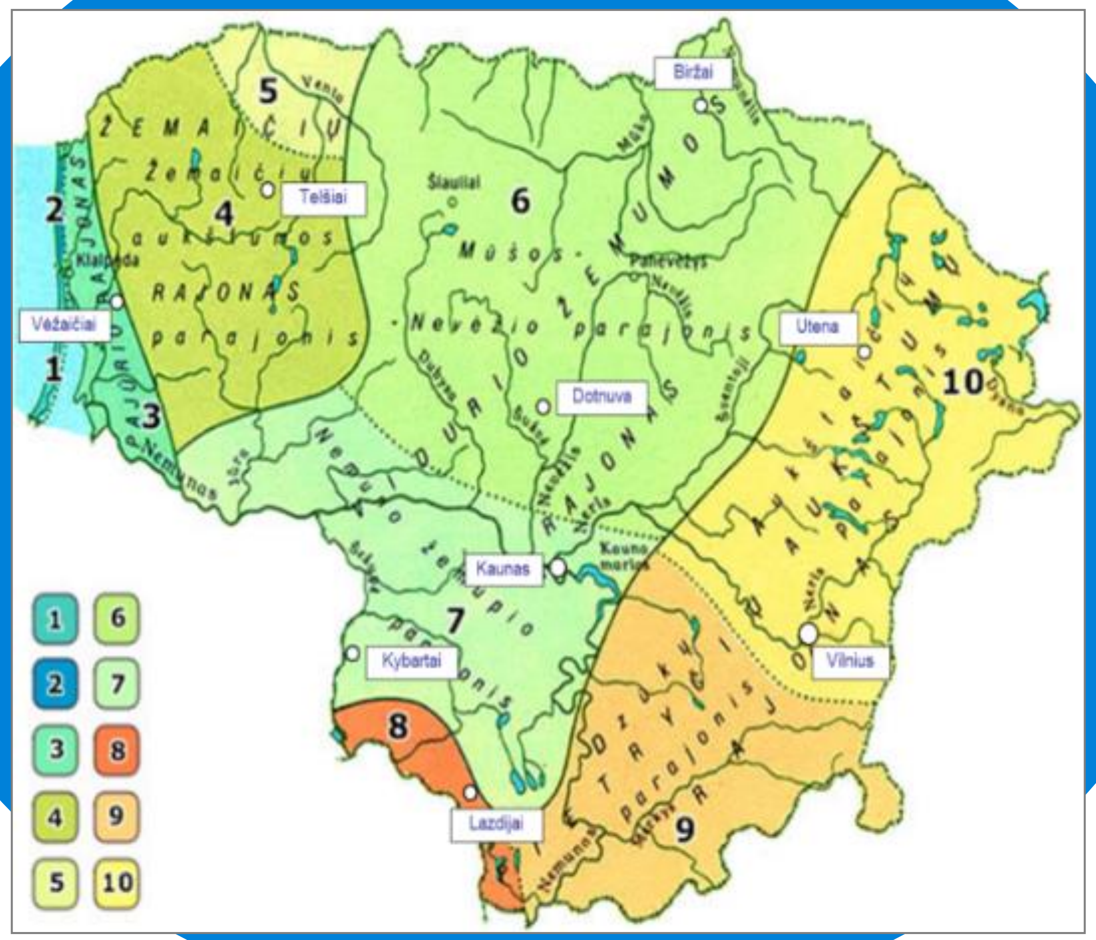
The aim of the work is to compare the values of soil productive moisture obtained by a thermostatic method using measurements from automatic agrometeorological stations (Watermark type) and determine drought period values for soils of different granulometric compositionю The following major criteria were applied to select the research object location: the established regions of Lithuanian climate, prevailing soils, network of Agrometeorological, and meteorological stations.

KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

MATERIALS AND METHODS

Soil moisture in meteorological stations is monitored using a porous gypsum block meter, where voltage drop (resistance) is measured between electrodes contained in porous material (gypsum block), having a direct contact with a soil.





The following major criteria were applied to select the research object location: the established regions of Lithuanian climate, prevailing soils, network of agrometeorological, and meteorological stations.

CALIBRATION OF WATER MOISTURE SENSORS

01

Soil moisture in meteorological stations is monitored using a porous gypsum block meter, where voltage drop (resistance) is measured between electrodes contained in porous material (gypsum block), having a direct contact with a soil.

02

Value interpretation (general guide values)	
0-10 cbar	Saturated soil
11-29 cbar	Soil is relatively humid (excluding coarse sandy soils).
30-60 cbar	Normal period for irrigation (excluding heavy clayey soils)
60-100 cbar	Time to irrigate heavy clayey soils
100-200 cbar	Soil becomes more and more dry

03

Watermark moisture sensors are installed in Lithuanian agrometeorological stations. Their main technical characteristics are provided in Table 1. These sensors are intended to estimate agrometeorological conditions; therefore, they are installed at depths of 20, 50, and 100 cm

04

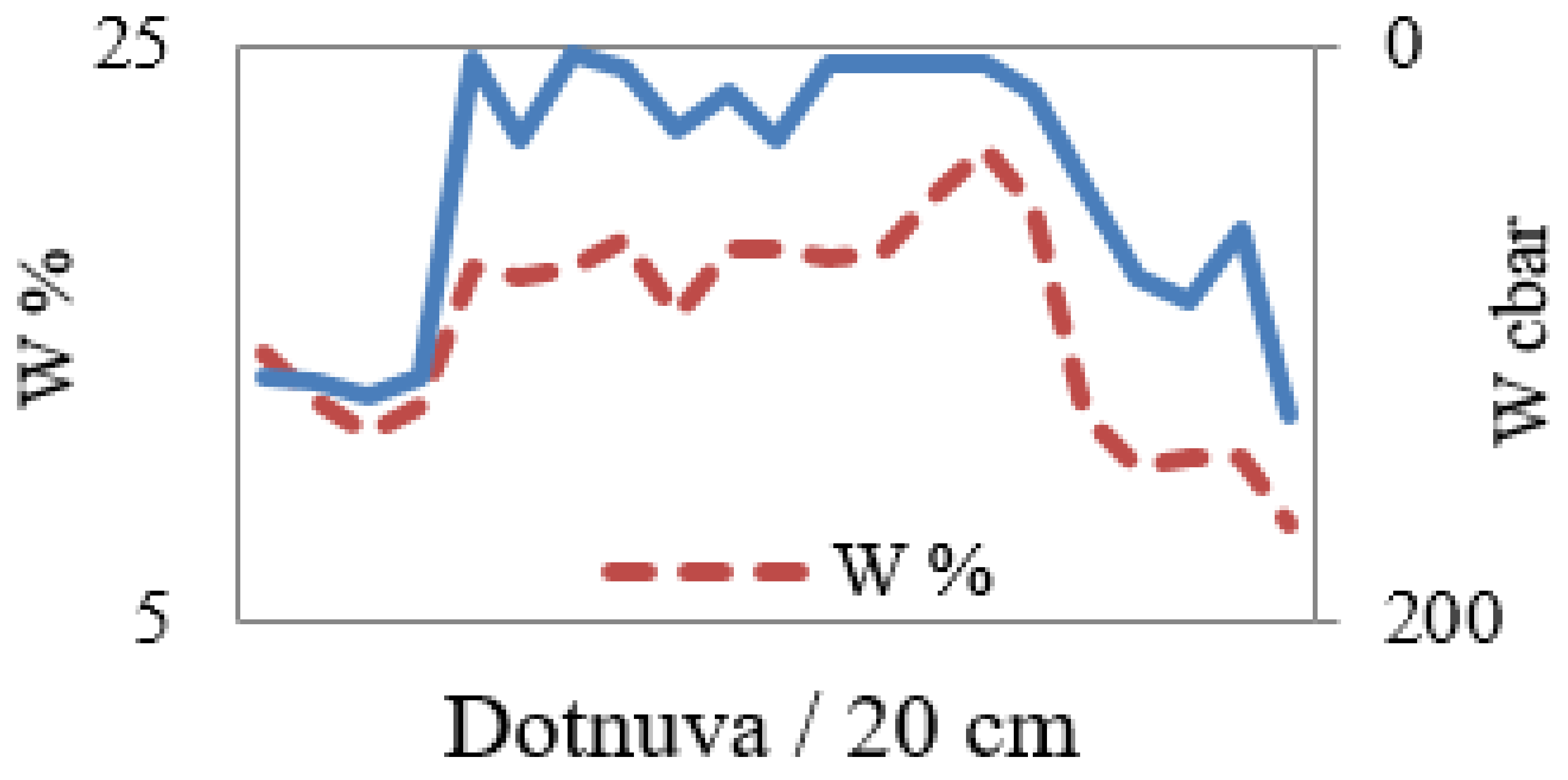
Moisture content in a soil layer V_n (mm) was determined using the following formula:

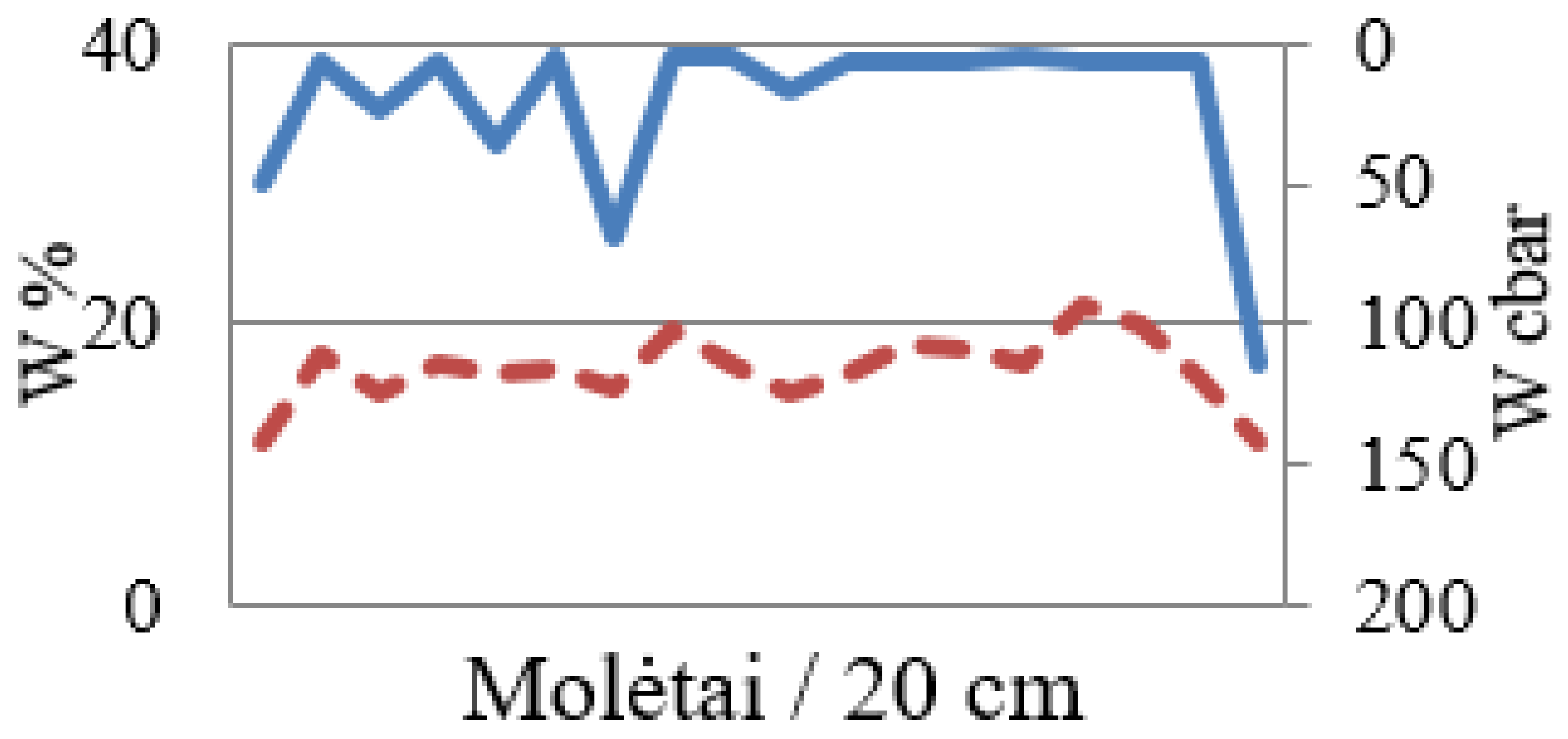
$$V_n = \frac{W_n \cdot \gamma \cdot h}{10},$$

where: W_n – moisture level in each soil layer %;
γ – soil density, g/cm³;
h – soil layer thickness, cm.

REASULTS OF RESEARCH

Graphical comparative analysis of moisture values determined by different methods (Watermark and experimental) shows that moisture dynamic variation is similar, values have the same graphical trends, and graph peaks approximately correspond to the soil moisture results obtained by the both methods.





Graphical comparison of daily average soil moisture values measured in meteorological stations using moisture meter and thermostatic method, cbar and percent (----- W, %; W cbar.)

KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

CALIBRATION OF SOIL MOISTURE SENSORS

01

The used moisture measurement instruments *Watermerk* have no relation with a volumetric soil moisture expression;

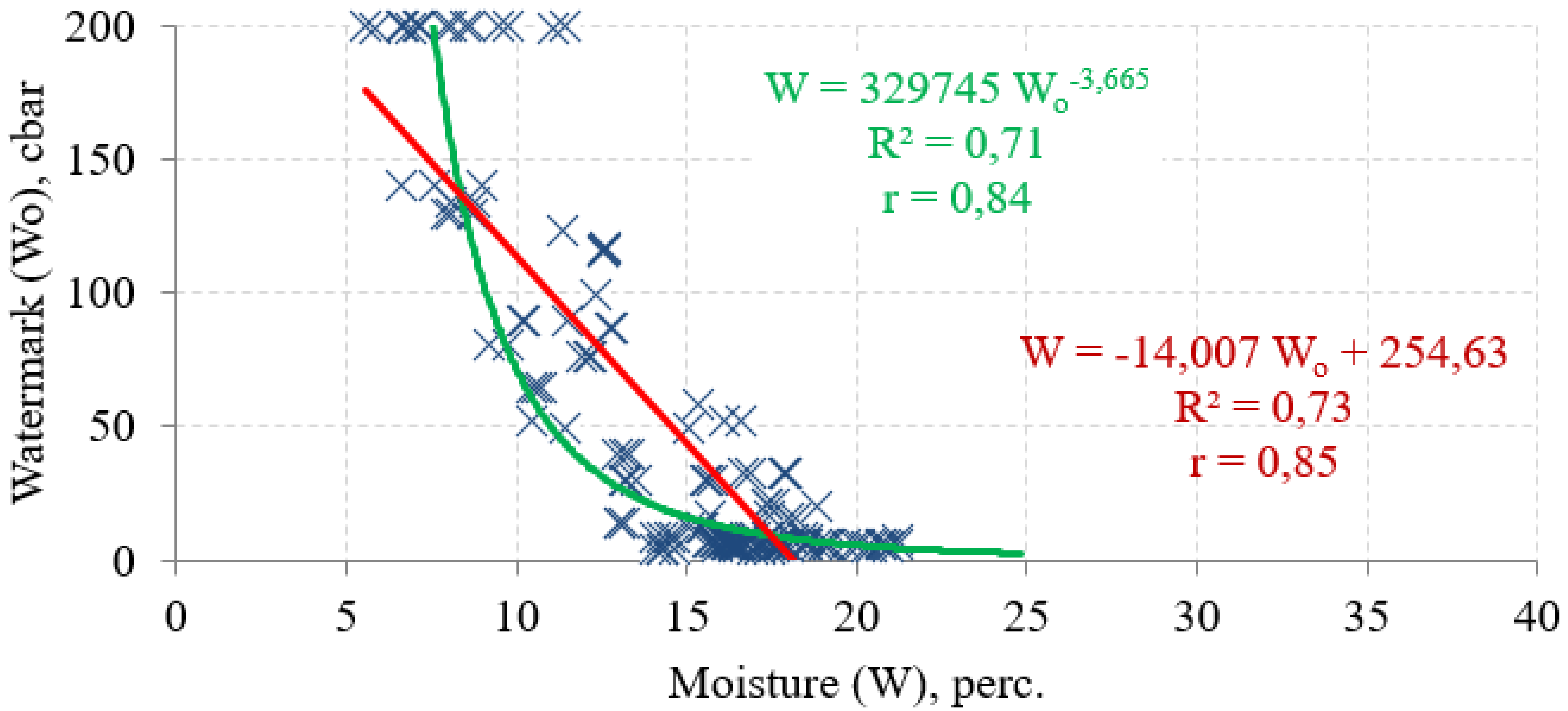
02

therefore, moisture values are measured only in cbar.

CALIBRATION OF SOIL MOISTURE SENSORS

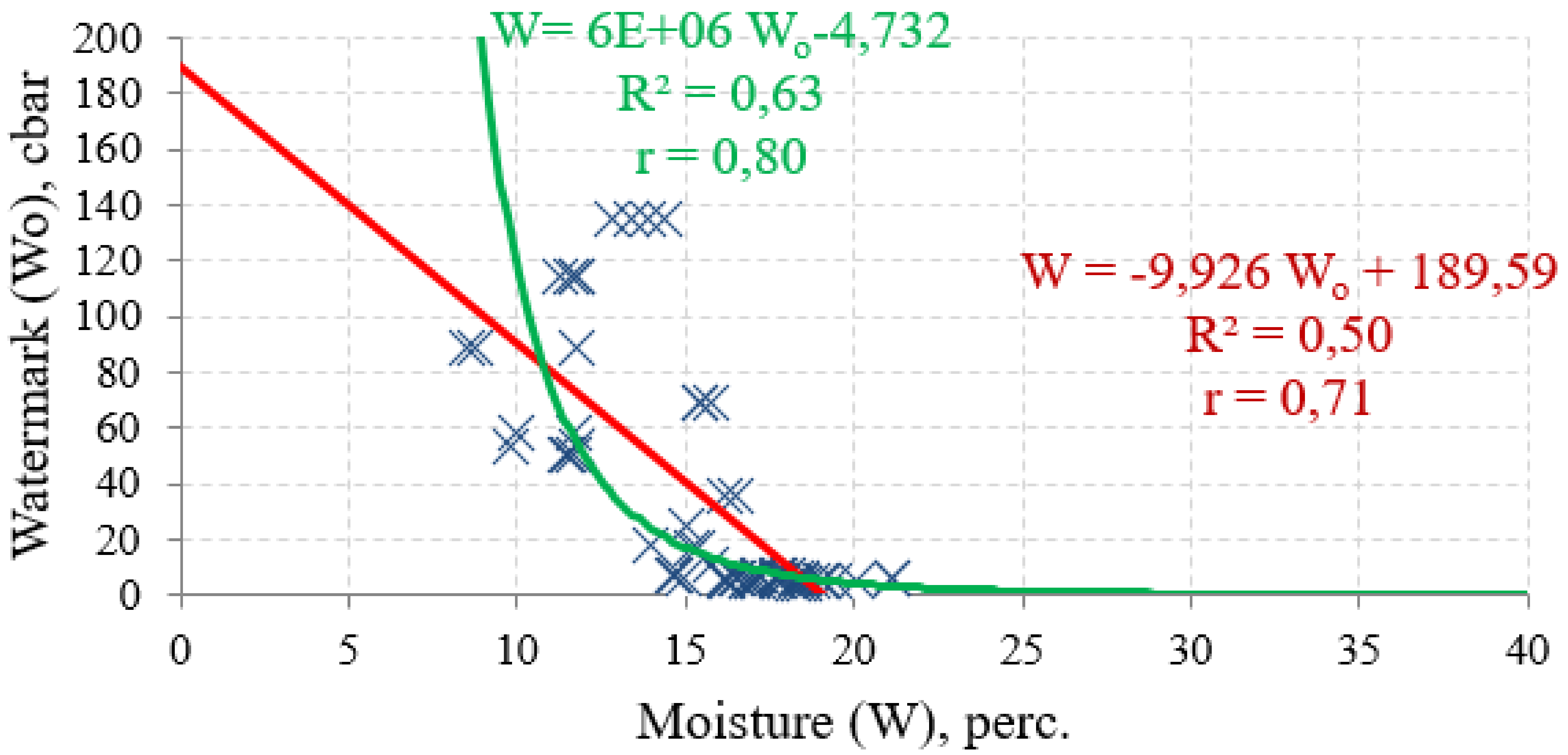
In order to estimate the actual moisture reserve, instruments have to be calibrated, i.e., cbar has to be linked to moisture contents by % or volume (mm).

CALIBRATION OF SOIL MOISTURE SENSORS



In *Dotnuva*, soil is calcareous; soils between 40 and 60 (50) cm from ground surface are Cley at the range of 50 cm below ground surface or up to the depth of 50 cm from the bottom of humus horizon arable layer. There is a strong relationship direction and inverse relationship between the numeric values of daily average soil moisture W_0 cbar and moisture determined by the direct-volumetric method W. Actual data covering drought period constitutes ~19 percent of the total number of samples.

CALIBRATION OF SOIL MOISTURE SENSORS



In *Molėtai* correlative relationship of the numeric values of daily average soil moisture W_0 cbar measured by a moisture meter and moisture determined by the direct-volumetric method W is inverse and strong, theoretically described by a power function. The major part of measuring results (~60 percent of total samples) is between 15 and 20 percent.

KAUNO MIŠKŲ IR APLINKOS INŽINERIJOS KOLEGIJA

CONCLUSIONS

Monitoring results cover optimal, medium wet, or wet periods, which corresponds to meteorological conditions and data.

Graphical comparative analysis of the moisture values determined by Watermark and experimental methods for the research period 2012-2013 shows similar trends of moisture dynamics, graph peak points approximately correspond to the soil moisture results obtained by the both methods.

Based on the completed analysis of the entire period values and the summarized results, it was determined that estimation of plant growth conditions period by HTK and actual soil moisture reserve (W, cbar) differ approx. 2-fold (according to HTK – 31 % wet and according to Watermark – 15 % wet).

REFRENCES

1. Dirsė A. 2001. Žemės ūkio augalų vegetacijos laikotarpių drėgmingumas. Žemės ūkio mokslai, 3: 51 – 56
2. Dirsė A., Taparauskienė L. 2010. Drėgmingumo kaita augalų vegetacijos metu ir jo vertinimo metodų palyginimas // Žemės ūkio mokslai. Nr. 1 – 2., 9 – 17.
3. Buitkuvienė M. S. Sausros Lietuvoje. Mokslinio tyrimo ataskaita. Vilnius: LHMT. 1998. P. 403 – 427.
4. Mannava V.K. Sivakumar . Agricultural Drought—WMO Perspectives. 22-34 psl. Agricultural Drought Indices. Proceedings of an expert meeting. 2–4 June 2010, Murcia, Spain. 205 psl. *Editors:* Mannava V.K. Sivakumar, Raymond P. Motha, Donald A. Wilhite, Deborah A. Wood
5. Palmer, W.C. 1965. Meteorological drought. *Research Paper* No. 45. U.S. Weather Bureau, Washington, D.C