UDC 006.91.631.4

M.Ie.Lazebna,
PhD (Agricultural Sciences)
National Scientific Center «Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky», Kharkiv

Metrological support in the field of soil quality: requirements, current status and ways of development

Purpose. To analyze the requirements and current state of metrological support in the field of soil quality; to determine the problems that exist in the direction of its development and to propose possible solutions. **Methods.** Analysis, generalization, systematization. **Results.** Normative - legal requirements for metrological support in the field of soil quality. The basic components of metrological control of soil state are defined. The problems and disadvantages of implementing metrological requirements in this field are determined. Ways of improving metrological support of works in the field of soil quality to improve the reliability and accuracy of measurement results. **Conclusions.** It is necessary to carry out the evaluation of soil quality with taking into account the requirements of the existing normative-legal documents, institutional, regulatory and technical aspects. Metrological control of soil state must be conducted by laboratories, which have clearly regulated requirements for appliances, executive staff and the most importantly, strict liability for the accuracy of the received information.

Creation of accredited laboratories on the basis of the leading scientific institutions, the introduction of harmonized standards for soil characterization methods and conducting inter-laboratory attestation measurements to verify the accuracy of measurements in laboratories, the scope of which includes such important object of the measuring as soil it is a prerequisite for development and improvement metrological support in this area.

Key words*: metrological support, metrological control, soil quality, requirements for measuring laboratories, measurement results.*

Introduction. Measurements in modern society play an important role. This especially applies to those areas of science that affect the safety of the environment, including the soils. The quality of the soil, in terms of its suitability for use in a given time or in the future, is determined by many different aspects that can be characterized by measuring the chemical, physical and/or biological parameters. Obtaining accurate, quality and reliable information is the basis for the soil evaluation and the balance between its use and conservation. Achieving these requirements is possible only with developing metrological support in this area.

Therefore, **the purpose of research** was to analyze the requirements and current state of metrological support in the field of soil quality; to determine the problems that exist in the direction of its development and to propose possible solutions. Achieving this goal was performed using methods of analysis, synthesis and systematization.

Research results. According to the Law of Ukraine "On metrology and metrological activity" (Article 3) [1] control of the environment state, including control of soil state are within the scope of legally regulated metrology. Metrological control can be conducted by laboratories, which have clearly regulated requirements and most importantly, strict liability for the accuracy of the received information.

Compliance with these approaches is possible only if the implementation in the laboratories on quality control systems, including implementation of requirements for accuracy (accuracy and precision) of methods and measurement results.

To fulfill these requirements in Ukraine there are implemented DSTU ISO / IEC 17025 [2], which regulated regulations for the competence of laboratories, DSTU ISO 9001 [3] – to the system of quality

control in these laboratories, and DSTU GOST ISO 5725 [4] – to the indicators accuracy of measurement methods and results.

Summarizing the regulations of these documents, metrological control of soil state should include: organizational, regulatory and technical aspects.

Organizational aspects include requirements for laboratories that are eligible to perform analytical works. Laboratory should have:

- Regulations on laboratory and its structure;
- job descriptions and functional responsibilities of staff;
- materials on certification of professionals and improving their skills;
- a set of documents on job evaluation;
- a set of documents relating to the certification of measuring laboratories for the right to perform analytical works (certification branch, passport, the management of quality, attestation certificate/certificate of accreditation, etc.);
- a set of documents to ensure work safety and fire protection (instructions, memos, posters, etc.);
- typical forms, work instructions, logbooks and other organizational and production documents related to reports on scientific and technical programs, work plans, contract orders, as well as the performance of specific production processes (reception, identification, selection and storage of samples, conducting analytical works, registration of results, etc.).

The laboratory has to conduct metrological control of the obtained results of analysis. Control on maintaining the quality in the laboratory should be performed by:

- internal laboratory operational and statistical control of accuracy of analysis results in accordance with the procedure regulated in the regulations or guidance approved by laboratory administration. The internal laboratory control is performed in order to: establish and ensure the validity of the results of measurements and determine the quality of performance in measuring laboratories or qualification of performers;
- external control of work quality in the laboratory, including interlaboratory metrological control of measurement results in accordance with current regulations.

Ukraine has Instruction [5], which establishes the procedure for checking the accuracy of measurements in measuring laboratories through inter-laboratory comparisons of measurement results and implements the requirements of the Law of Ukraine "On metrology and metrological activity" [1] concerning unity of measurements in Ukraine. But, unfortunately, in the area of soil quality, this instruction is not implemented sufficiently. To solve this problem, it is necessary to develop a Program of interlaboratory comparative measurement results with obligatory participation of measuring laboratories of research institutions and laboratories of regional affiliates of SI "Institute for Soil Protection of Ukraine". Coordinator of these works can be National Scientific Center "Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky", which fully meets the requirements established by these Regulations.

An important thing is the availability of set of materials on the results of the comparative interlaboratory measurement and control in the field of soil quality and a set of documents from internal and external audit of quality of works.

To legal aspects it is related security of laboratory with actualized normative and methodological base. Applicable ones should be only standardized methods or qualified measurement techniques. Thus for the international recognition of the results of analytical measurements preference should be given to methods or techniques, harmonized with international and European regulations.

Unfortunately, in Ukraine there are problems with the implementation of standards for methods of characterization of soils, their composition and properties, as well as approaches to evaluation procedures of their condition, because modern material and technical conditions of laboratories are inadequate for implementation. So it should be created modern analytical centers, preferably in the leading scientific institutions that need to be equipped with not only modern equipment, but also to introduce modern approaches to the proceeding measurement results and have professionals that in light

of the measurement results will provide scientifically based evaluation of the data and practical recommendations for further actions.

In order to meet production processes on a single scenario (reception, identification, selection and storage of samples, conducting analytical works, registration of results, etc.) it should be developed and approved by the Ministry of Agrarian Policy and Food of Ukraine a relevant list of regulations, preferably harmonized with international and European standards. This will enable to compare the test results obtained in different laboratories, and thus improve the recognition of test results by different countries.

The technical aspects necessary to ensure metrological control in organic farming are:

- laboratory and ancillary buildings and their technological support (electromechanical, sanitary, air, etc.), including means of control for work conditions (temperature, humidity, pressure, noise, vibration, etc.);

- testing and support equipment (distillation, thermostats, sterilizers, centrifuges, drying cabinets, etc.);

- measuring equipment, including the required standard samples of substances and materials in accordance with GOST 8,315. [6] In Ukraine, the development features of standard samples of public and sectoral levels are assigned to the Center for State Service of Ukraine Standard Soil Samples, which was created at the National Scientific Center "Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky" [7]. Center serves as an active participant from Ukraine within the framework of the Eurasian community of National Metrological Institutions (KOOMET) on the establishment of standard samples of structure and properties of substances and materials;

- supplies (solvents, reagents, compounds, filtering tools, etc.);

- individual safety and fire protection equipment (clothing, rubber gloves, goggles, respirators, fire extinguishers, etc.).

Thus, for the evaluation of soil measurement results must be obtained in accredited laboratories by certified methods with established characteristics of errors in the presence of external and internal quality control measurements, reference materials, systematic verification of measuring instruments, reagents, dishes, availability of existing regulations.

Today in Ukraine evaluation of soil quality is carried out mainly by certified measuring laboratory, but according to the Law of Ukraine "On metrology and metrological activity" [1], and in accordance with the requirements of Concept of optimization of national laboratory network and action plan for its implementation [8] there is provided a creating network of the most competent laboratories of state ownership, accredited by the National Accreditation Agency of Ukraine recognized in Ukraine and abroad.

Accredited laboratories that operate according to the requirements of DSTU ISO / IEC 17025 and carry out analyses to determine the characteristics of the soil, there are only 19 [9], of which 5 - based on a branch of SI "Institute of Soil Protection of Ukraine", but qualified analysts are not always experts on providing scientifically based recommendations on improving the quality and efficient use of soil, that is qualified characteristics of the results.

In view of this, metrological support in the field of soil qualities requires access to a new level with obligatory participation of specialists of relevant scientific qualification. Therefore, it is reasonable to create accredited laboratories in the leading scientific institutions.

This approach will contribute to the development and improvement of metrological support, and the most importantly, will be a significant factor in increasing efficiency of scientific research in the field of soil quality.

Conclusions.

Soils as environmental object belonging to the metrological control as to assess their state it is necessary to comply with requirements of DSTU ISO/IEC 17025, DSTU ISO 9001 and DSTU GOST ISO 5725, organizational, legal and technical aspects, and the most importantly, to improve the accuracy, quality, reliability and validity of the data obtained during the analytical studies it is required to conduct internal and external control of work quality in the laboratory. The ways for development of metrological support in the area of soil quality, including the establishment of accredited laboratories in the leading

scientific institutions, implementation of harmonized standards for methods of determining the characteristics of the soil and the requirement for inter-laboratory measurements to verify the accuracy of measurements in laboratories, the scope of which includes such important objects of the measuring as soil.

References

1. On metrology and metrological activity: the Law of Ukraine : [adopted in February 11, 1998 № 113/98-ВР : 10.06.2012].

2. General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005, IDT): DSTU ISO/IEC 17025:2006. – [Valid from 2007-07-01]. – K .: Derzhspozhivstandard of Ukraine, 2007. – 32 p. - (National Standard of Ukraine).

3. Система управління якістю. Вимоги. (ISO 9001:2008, IDT) : ДСТУ ISO 9001:2009. – [Чинний від 2009-09-01]. – К. : Держспоживстандарт України, 2009. – 34 с.

Quality management system. Requirements (ISO 9001:2008, IDT) : DSTU ISO 9001:2009. – [Valid from 01.09.2009]. – K.: Derzhspozhivstandard of Ukraine, 2009. – 34 p.

4. Accuracy (accuracy and precision) of measurement methods and results: DSTU GOST ISO 5725: 2005 (GOST ISO 5725-2003, IDT). – [Valid from 2006-07-01]. – K .: Derzhspozhivstandard of Ukraine, 2006. – 334 p.

5. Instructions on how to check the accuracy of measurement results in measurement laboratories: [approved by the Derzhstandard of Ukraine from 12.08.99 № 99] (as amended)

6. NSM. Reference materials of composition and properties of substances and materials. Key points : GOST 8.315-97. – [Valid from 1998-07-01]. – M .: USSR State Committee on Standards, 1998. – 26 p.

7. Regulations on the State Service of Soil Samples of National Scientific Centre "Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky." – [Valid from 17.02.2009]. – Kharkiv, 2009. – 4 p.

8. Concept of the national laboratory network optimization : [approved by the Cabinet of Ministers of Ukraine from July 24, 2013 p. № 719-p].

9. The list of testing laboratories accredited in compliance with DSTU ISO/IEC 17025. – Access to the electronic page: http://naau.org.ua/reyestr-akreditovanix-oov.