LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
Faculty of Agriculture and Food Technology

ACCOMPLISHMENT AND LAYOUT OF STUDY ASSIGNMENTS

Methodical instructions for students of the
Faculty of Agriculture and Food Technology
studying in English

Jelgava 2023

The methodological instructions are intended for students, supervisors and reviewers, academic staff.

Considered and clarified at the meeting of the Faculty's Study Methodical Commission February 20, 2923 Nr. 7.1.-24/3

C O N T E N T

I N T R O D U C T I O N

Professional activities of university graduates include the sharing of their knowledge and expertise with the general public and non-professionals in the field. Therefore, it is important that students learn and master effective communication skills – the ability to express their thoughts and ideas verbally and in written form. When concluding a certain university qualification level or obtaining a Bachelor's or Master's degree, students should have acquired an appropriate level of communication skills. We are living in the Information Age now; therefore, the success of professionals to a large extent is determined by their ability to orient themselves in and be able to deal with increasingly huge amounts of information, to process, analyze and interpret it, to prepare illustrative surveys or reports and to present them to target audience in an easily comprehesible form. Each idea should be convincingly, clearly and instructively described in written form and afterwards defended orally, and the successs will depend on the topicality of an idea, its definition, the analysis of existing situation, the argumentation as well as the layout of a work or project.

Professional writing certainly is a creative process; however, there are formal and informal standards (elaborated or established) the observance of which is an essential precondition for the acceptance of a student's written work. Frequently, the disregard and ignorance of these standards, as well as their inconsistent observance and too "creative" interpretation are the reasons why the work should be revised or is even rejected. Therefore, the skills required in professional writing should be gradually acquired also in a study process while performing independent work assignments. For that reason, the present Methodical Instructions provide the necessary requirements for the students of Bachelor and Master programmes. These Instructions are envisaged for all types of written work that students have to accomplish within a study program: reports of laboratory and practical work, written tests, reports and essays, practical training reports, course papers and projects, papers for scientific proceedings and journals, conference theses, and Bachelor and Master theses. These requirements should be observed in all written work assignments of the Faculty of Agriculture and Food Tecnology (LPTF) of the Latvia University of Life Sciences and Technologies (LBTU). Also, they should be followed by the students of other LBTU faculties who attend study courses delivered by LPTF academic staff[1].

The present document comprises information on the choice of the topic, the development and presentation of Bachelor and Master theses, the basic requirements for all types of written study work and their assessment criteria at the Faculty of Agriculture. The Regulation of Studies and other standards confirmed by the LBTU Senate are the basis of these Instrucions. If any changes are made in the existing LBTU standards, also the present Methodical Instructions can be modified; therefore, they should not be considered legally binding in case they contradict the existing LBTU documentation. The Faculty of Agriculture and Food Technology does not take responsibility for any conflict situation which may arise due to inadequate interpretation of these requirements.

[1]Students of other faculties must follow these Instructions as far as they comply with the corresponding standards of the respective faculties.

1. TYPES OF STUDY WORK

There are several types of study work which motivate students to acquire and master professional writing skills. They can be divided into three groups:

- independent work assigned in the study process – reports of laboratory and practical work, written tests, reports and essays, practical training surveys;
- conference theses, scientific papers;
- final work of the studies – Bachelor and Master theses.

Study works can greatly differ thematically; however, a certain order and uniformity should be observed in their arrangement and layout basing on professional writing traditions and on the standards for the use of measurement units. These Instructions apply to the study work both in paper format and electronic format.

1.1. Independent work set in the study process

Reports of laboratory and practical work. Students create reports during or after the accomplishment of all practical work: describe the outcomes, conduct their assessment and draw conclusions. The mastering of practical skills and the assessment of obtained results add to the theoretical knowledge acquired in a particular study course. The reports serve as a basis for accepting the laboratory or practical work and are a significant part of the final assessment of a study course. The layout of reports may vary, which is determined by the academic staff member who is supervising the particular work. Reports can be created either on a standard paper taking into consideration corresponding instructions or on preliminary elaborated forms. Usually, the lab and practical work reports contain the title of the completed assignment, its theoretical background, characteristics of the material or process under analysis (research), outcomes of the assignment (observations, measurements), calculations, the conclusions drawn, interpretation of the results, information on the author (name, surname, matriculation No., faculty, group), and submission date of the report. A report should fully reflect a student's work, all calculations, results obtained, and student's ability to put them into practice. Pages of a report are numbered and fixed with a clamp or otherwise. After reviewing and accepting the work, a lecturer returns the report to its author[2] who keeps it until the end of the respective study course.

Written tests and other independent work. Tests are done during classes or at another time, and they help to check student knowledge about a particular subject. The main requirement for designing these tests is clear, logical and possibly complete answers in a clear and intelligible handwriting. The average score of successfully written tests during a semester can be used for final evaluation of the study course and can substitute an examination.

The independent work reflects a student's understanding about the questions put in a test, the ability to generelize the information and independently solve the set task or offer a personal solution to the given case; therefore, direct rewriting of solutions already analysed in the literature is not alowable. Quotations that fit the context and add to a student's own thoughts can be used providing an in-text citation directly after the quotation.

The independent written work consists of: a title-page (Appendix 1), the formulation of an assignment (questions), answers, and a reference list. The independent work can be

[2] If there are no other instructions in a study course.

submitted electronically through e-learning environment or in a printed form (in compliance with a lecturer's instructions). The printouts are either stitched into a folder or fastened together with a clamp.

Reports and essays are written on a particular topic, or they can be a description of the experience students have obtained. The character, subject-matter and amount of reports and essays are determined by a lecturer of the respective study course. Report preparation includes the study of literature and the summarization of information supplemented with a student's own personal assessment of the problem under discussion. Reports add to the theoretical knowledge acquired in a study course. When preparing a report it should be taken into account that:

- the required information should mostly be gathered from scientific and professional literature sources (research papers, monographs, conference theses, standards, branch periodicals, etc.);
- a report is not the compilation of quotations and fragments from literature sources. It is an author's creative work, where the student critically approaches the data found in literature sources, reveals both contradictions in and uniformity of the opinions of different authors, and draws conclusions about yet unclear and not studied aspects of the particular issue.

The content of an essay should be written in a free form. Students convey their thoughts, experience and point of view on a certain topic, phenomenon or issue. However, essays should also be coherently structured, in a good compositional and stylistic form, appropriately designed. The title page of an essay is designed analogous to that of a course work (Appendix 1).

The printout pages of a report or an essay are stitched into a folder or fastened together with a clamp. Afterwards, the written work in a printed form or electronically (according to a lecturer's instructions) is submitted to a lecturer in due time. The accepted reports and essays are not returned back to their author.

The **practical training survey** is prepared basing on the type and programme of practical training. The creation of the survey and the accomplishment of practical training take place simultaneously. The survey includes: materials of the assignments completed each day, calculations, descriptions, conclusions, and the created maps, schemes or other materials indicated both in the practical training programme and in the task of a particular assignment. The produced material is stiched into a folder or fastened together by a spiral of wire, and attached are the contents page and the title page that is created analogous to that of the course work (Appendix 1). When submitting the survey electronically (e.g., in e-studies environment), the layout remains the same. Finally, the survey presents general conclusions covering the whole training period: assessment of the conclusions drawn, their significance in the acquisition of the respective study course, the acquired theoretical knowledge and practical skills, as well as improvements necessary for the organisation of traineeship and the student's own suggestions for their implementation.

If certain tasks are accomplished by a group of students, then the task records can be partly joint and prepared as a single copy attached to the survey of one of the students. Other students individually prepare their conclusions and make reference to the respective student's survey to which the task records are attached. The survey should be created so that the required material is logically and completely arranged.

The practical training survey is kept for five years.

1.2. Papers for scientific proceedings and journals. Conference theses

Students and Master students write conference theses and papers for scientific proceedings and journals basing on independently carried out experiments, the experience gained at practical training, or the knowledge gained through literature studies.

Papers for journals are prepared according to the guidelines of each particular publication which may differ from those described in the present Instructions. Also, the structure and volume of papers will differ depending on the character, target audience and specialization of a particular publication.

1.3. Final theses of the studies

Final theses are Bachelor thesis and Master thesis.

Different study levels have different requirements and criteria for the qualification level of diploma applicants, and consequently also the aim, contents, and scientific and professional level for preparing the final theses differ; whereas, the arrangement, design, submission and evaluation of final theses have much in common.

Final theses are prepared at the end of each study stage and they reflect the qualification level of a diploma applicant, the skills acquired, and professional maturity. They also show the performance quality, professional standards and creative potential of the members of a study programme and academic staff; therefore, particular and scrupulous attention should be paid to the creation of the final theses as their evaluation determines the final, several-year study outcome.

1.3.1. The aim of creating the final thesis

Higher education diploma applicants not only should have extensive knowledge on the production of sustainable agriculture and its unity with the surrounding environment, but should also be able to independently carry out a research work. The final thesis confirms that a diploma applicant has acquired adequate knowledge and skills and is able to apply them in practice.

A **Bachelor's degree** applicant should be able:

- to use the scientific and professional literature;
- to identify and define the technological problems of the chosen science sub-branch;
- to apply scientific methods;
- to summarize and analyse scientific research results;
- to publicly discuss the research results obtained.

A **Master's degree** applicant should be able:

- to demonstrate profound knowledge in the chosen Master thesis topic;
- to generalize and extensively analyse scientific literature with regard to the research results obtained;
- to assess and choose a research methodology respective to the chosen thesis topic;
- to openly discuss novel ideas and hypotheses and substantiate the conclusions drawn.

1.3.2. The choice and approval of the thesis topic

Students of the academic Bachelor study program "Sustainable Agriculture" submit a written application to the LPTF Dean's office in the 2nd semester, until March 1, indicating the preferable research direction which they have preliminary coordinated with the potential scientific supervisor. Students are welcome to consult the director or academic staff members of a study programme on the thesis' topic.

According to the plan of a Bachelor study programme, until the end of the 4th semester students together with their scientific supervisor taking into consideration their mutual interests and possibilities, agree upon the topic, aim and assignment of the final thesis, the assignment implementation methodology, and prepare the thesis' assignment according to a set form (Appendix 2 – the form is available at www.lptf.lbtu.lv). After supervisor's approval, students submit the Bachelor thesis assignment to the Dean's office.

Students carry out their experimental or research work in the 4th–5th semester; however, for a more thorough and comprehensive thesis creation it is advisable to start the research already in the first or second study year.

Master thesis assignment (Appendix 2 – the form is available at www.lptf.lbtu.lv) should be submitted according to a study plan.

The thesis assignment is specified at the pre-defense. The director of a study programme approves the final thesis' assignment and attaches it to the final thesis.

The title of the thesis in Latvian and English should be approved by the order of the LPTF Dean, which is prepared after the pre-defense. Afterwards, no changes or additions are allowed.

The amount of the final thesis in a Bachelor study programme is 12 CP, and in Master study programme – 25 CP. The thesis supervisor periodically assesses the peformance of thesis creation taking into consideration the summarised data, data processing results, and discussions with students and makes respective entries in the examination list in the semester indicated in a study plan.

According to a study plan, three entries are made for students studying in **Bachelor programme**:

- first entry (2 CP) – if a thesis topic is formulated and the assignment task is defined and approved by the supervisor and submitted to the Dean's office (Appendix 2);
- second entry (4 CP) – for a successful accomplishment of the thesis. The literature is studied and literature review is prepared and publicly defended at a department of the respective institute in the 5th semester;
- third entry (6 CP) – after a successful public defense of the final thesis.

For **Master students**, also three entries are made according to a study plan:

- first entry (6 CP) – if the thesis topic is approved, the work assignment is prepared (Appendix 2), individual work plan for the whole researh and thesis' preparation period is elaborated, the methodology is verified, and literature studies and/or research work are commenced;
- second entry (5 CP) – if literature review is written and publicly defended;
- third entry (14 CP) – after s successful public defense of the final thesis.

1.3.3. The methodology for creating the final work

The thesis of an LPTF academic **Bachelor's degree applicant** may be based on experimental work or on literature studies and analysis. The methodology for preparing the final work should contribute to the achievement of the set goal and the accomplishment of the tasks proposed to reach that goal. Branch-specific methodology and criteria should be used for data processing. In case students are involved in a project carried out by their institute or scientific supervisor and the collected data are also used in the creation of the final thesis, students must refer to the data acquisition source and **explicitly describe their own contribution in the obtaining, processing and summarization of experimental data**.

In the course of thesis creation it may be useful to involve an advisor who is an LPTF academic staff member or a researcher at an LBTU cooperation institution.

1.3.4. Data summarization

This sub-chapter deals with the final theses that are elaborated on a research/experimental basis.

Students preparing a Bachelor's or Master's degree thesis basing on experimental research should compile and intelligibly and meaningfully arrange a sufficient amount of data and information. In the course of thesis creation, the data are compiled and organized in an electronic, printed or written form according to the supervisor's instructions and mutual agreement.

It is advisable to create a research notebook where to record all information regarding the experimental work. A student stores and summarises the thesis' primary documents (observations in nature, measurements, copies of documents, primary data base, calculations, etc.) in an electronic or printed form.

If a student is working within the framework of a certain project, the data obtained may be kept with the project leader.

The order of data recording and information summarization. In each particular case, the information should be summarised according to the specifics of each research work and in coordination with the scientific supervisor (Appendix 3). A primary-document folder may be an electronic document management system, or it may consist of separate consecutively numbered and stitched pages (e.g., in a folder), or it can be an appropriate-size notebook. Primary documents are prepared during the execution of the experimental work (on a field, in an animal shed, in a laboratory, etc.); therefore, design accuracy of the documents is not evaluated but important are the contents and origin of data as they reflect student's individual contribution in conducting the experiments. This is why students should compile and summarise primary documents (original notes made on a field, excerpts from the notes or their copies (also photocopies), laboratory analysis request forms, etc.) but not the variants rewritten after accomplishing the experiment (fair copies).

If a student is involved in some project, the field (laboratory) data can be kept with the project's supervisor. In that case, different draft calculations and other documents are compiled in a special folder, indicating the place where the original data are placed.

Also, if a student makes use of different accessible data bases, it is not necessary to present obtained data in a printed form; instead, draft calculations and the information about their retrieval site are noted in the primary-documentation folder. Students electronically store experimentally obtained data mathematical processing worksheets generated by the utilized software (*MS Excel, SPSS,* or other), as well as include all criteria significant for

data interpretation into the basic text and/or in Appendices and conduct the analysis of obtained values.

The scientific supervisor takes into consideration the summary of the research data and information to decide on making an entry in the examination list.

Primary documents in an electronic, printed or written form should be presented on request to a final thesis' reviewer or to the examination commission.

1.3.5. Arrangement and layot of the final thesis

The material obtained during thesis accomplishment should be arranged meaningfully and consistently taking into consideration generally accepted principles. By its structure, arrangement and layout requirements, the final thesis is similar to any research report or project on a particular topic.

The work has two parts: basic text and appendix. The basic text includes the main material. The appendix contains supplementary material, observation data, calculations, substantiations, reference documents, etc. and less significant material necessary for the understanding of the basic part. It must be noted that supplemental part should not be overloaded with unuseful material. The full set of primary documents and calculations is kept with the author of the final work.

The **structure of the basic part** of final thesis depends on the character of a thesis (experimental research or literature analysis):

- **experimental research paper** consists of a title page, annotation, table of contents, introduction, literature review, the conditions and methodology of an experiment (research), research results and discussion, conclusions, annotation in Latvian, acknowledgment (if relevant), reference list, and appendices;
- the final work based on **literature analysis** consists of a title page, annotation, table of contents, introduction, literature analysis appropriate to the thesis topic, conclusions, annotation in Latvian, acknowledgment (if relevant), reference list, and appendices.

Explanation of the parts of final thesis

Title page is created according to a uniform pattern (Appendix 4). The title page is included in the total amount of thesis page numbering but has no page number on it.

Annotation is a brief overview of the thesis content revealing its novel ideas and other information which allows the reader to consider the benefit from reading the entire work. The Annotation should be written following a unified scheme: bibliographic information, research objective, accomplishment methodology, research results, main conclusions, and spheres for the application of obtained results. The text should be concise, logically arranged, acurately formulated; its amount – at least 2500 characters not exceeding one page. At the beginning of Annotation, the total number of pages is given, whereas the number of pages of the basic part (up to the References) and the number of tables, pictures, reference sources and appendices are given at the end of the Annotation (Appendix 5).

Additionally, also the short version of Annotation should be prepared (Appendix 8). After submitting the electronic version of the thesis, the short Annotation is entered into the LBTU Information System (IS) to ensure the bibliographic description and classification of the final theses. The amount of the short Annotation does not exceed 850 characters (including spaces), and its contents may differ from that of the full Annotation.

The Contents lists all numbered headings with respective page numbers. An example how to arrange the Contents is shown in Appendix 7. When preparing the Contents part it is recommended to use the automatic Table-of-Contents function.

Introduction. Topicality of a thesis and its theoretic and practical significance are formulated, and the thesis objectives and tasks are set. If a final thesis is created within the framework of a certain project and already earlier accumulated experimental data are utilized, then the project title must be indicated. The Introduction part should comprise data acquisition sources and the author's individual contribution in data collecting and processing. Besides, the Introduction provides information about the author's publications (including submitted ones), presentations at conferences, participation at competitions, or other public presentations of the research results obtained. The introductory part should not exceed two pages.

Literature review. When creating a literature review, students must study the recent scientific and professionally most significant sources relevant to their research theme and must comprehensibly and systematically reveal the existing situation in the field – what has already been studied, what has been partially studied or has not been studied at all concerning the particular issue. Literature review should be concise, with the author's own assessment of and critical approach towards the latest information under the research interest. It is advisable to use the research results that are long-term as they are more reliable and that correspond to Latvia's specific soil and climatic conditions. Contradictory results that are found in different literature sources about similar issues should be especially thoroughly analysed pointing out the conditions in which the respective information was obtained. Therefore, if possible, students are recommended to find the reasons for the differing research outcomes, for example, about contrasting agrometeorological conditions.

The literature review should be logically arranged in thematic and chronological succession basing on the objectives and tasks defined in the thesis and may include scientific journals, monographs, scientific research proceedings, research reports, doctoral or PhD theses, and other scientific research sources as well as other kinds of professional literature.

When creating Bachelor and Master theses, students should refer to professional journals if they have to characterize the situation in Latvia and there are no other relevant sources. Textbooks and other types of summarizing sources, for example, handbooks, should not be used in a literature review. However, though it is impossible to draw a precise borderline between the literature sources – which may and which may not be used in preparing a review –. they reflect the degree of applicant's qualification level and ability to critically sort, apropriately analyse and creatively interpret the information, instead of just rewriting or paraphrasing certain texts from any source. In thesis assessment, the quality of literature sources, the analysis of the information obtained, and the extent of its generalization are of major importance. In-text citations and bibliographic descriptions should be accurately and properly written (see Chapter 2).

Literature review is concluded with a brief annotation or conclusions drawn by the author – as a response to the thesis objective defined in the Introduction part.

For creating a Bachelor thesis of experimental character, at least 30 literature sources should be used and for creating a Master thesis – at least 50 sources apart from those mentioned in footnotes.

If a Bachelor thesis is a literature review, students must choose at least 70 sources from refereed (peer-reviewed) scientific research publications (journals and proceedings) apart from those mentioned in footnotes.

The evaluation of a Bachelor thesis depends on the quality of the used literature. **A good (7) or a higher estimation is earned if a reference list contains at least 50% of scientific sources.**

Research (experiment) conditions and methodology. The information on research time, place and conditions is described consecutively, concisely and completely pointing out those aspects that are connected with research issues or that can substantially influence them.

In general, regardless of the specifics of a particular research, its contents and performance should be described so that the reader could repeat all experiments and calculations. Irrespective of the amount of information, this chapter should be concise and not exceed seven pages or 15% of the total amount of the thesis up to the Reference list.

Research results and discussion. The obtained and processed data, expressed in comparable and generally accepted measurement units in the relevant branch, are grouped into thematic subchapters. Research results are arranged in the form of tables and figures (diagrams, graphs, photographs, drawings, etc.) taking into consideration layout requirements (see Subchapters 2.2. and 2.3.).

When preparing the final work, especially in Master programme, attention should be paid to data analysis. The data obtained should be interpreted employing the results of data mathematical processing (if applicable), the influence of meteorological or other conditions on research results, and the biological, agronomic and zootechnical logic. Explanation of the results should be based on literature data, and the discussion should be created by comparing own results with the data found in the literature.

Depending on the theme of a final work, the ecological, economic or sociological assessment of research results may be required.

Conclusions, recommendations. Conclusions summarize the substance of a thesis basing on the acquired data and their analysis and encompass answers to the tasks set in the Introduction part. They should be concise and precise, defined in the form of statements, and sequentially numbered. The number of conclusions usually does not exceed 8–10. Conclusions are based solely on the researh results acquired by the author, and they must not cover issues not directly connected with the subject matter of a thesis. If a thesis deals with practical issues, its author may give practical recommendations regarding the implementation of research findings.

Annotation. Final thesis should be supplemented with an Annotation in Latvian using professional terminology; an example is given in Apppendix 5.

Also, **a short Annotation both in Latvian and English** should be written**.** When submitting the thesis' electronic version, both short Annotations are entered into the LBTU IS to create the bibliographic description and classification of the theses. The amount of the short Annotation should not exceed 850 characters (including spaces), and its text may differ from that of the full Annotation (Appendix 8).

Acknowledgment. Appreciation and gratitude (if relevant) to persons, institutions and enterprises that have extended significant methodical, advisory, financial or technical support in the planning and implementation of the experiment, in data processing, in designing the layout of the thesis and visual aids. The Acknowledgment does not include scientific supervisor(s) and officially selected and approved advisors as well as staff members whose duty is to organize and supervise thesis preparation. The expression of appreciation and gratitude should be constructive and considerate avoiding excess praise for the support and services that have not been of substantial importance. An example of an acknowledgment is given in Appendix 9.

References. The list of References contains the literature and information used in a final thesis, arranged in an alphabetical order, and includes only those bibliographic sources that have been cited in the main text (see Subchapter 2.7.). At first, all sources in the languages of Latin-origin alphabet are arranged, and afterwards – the sources using the Cyrillic or other types alphabet.

Appendices. Instructions for the creation and layout of supplementary material are summarized in Subchapter 2.8. The first supplemental material of a final thesis always is the thesis' assignment approved by the Faculty of Agriculture and Food Technology (see Appendix 2). Appendices may contain: calculations, significant intermediate results, figures, descriptions, as well as various reference materials and conclusions pertaining to the work.

Layout of a final thesis. Final thesis should be constructive, accurately and meaningfully created, not exceeding the maximum allowable amount: up to 50 p. for a Bachelor thesis and up to 75 p. for a Master thesis (for the basic text excluding the Reference list and Appendices).

A printed final thesis is bound in hard covers. An envelope (size 165×230 mm) containing a review and other expertise and reference documents is fastened with glue at the inside of the back cover.

1.3.6. Submission and reviewing of the final thesis

A certain submission procedure is established which should be followed to meet the thesis submission deadline set by the order of the LPTF Dean.

At least one month prior to final thesis submission, the director of a respective institution organizes a thesis pre-defense meeting at the department where the thesis was created. A student prepares an unbound manuscript of the basic part of a thesis, attaching the primary documents to it if requested. At the pre-defense, students deliver a report and reply to the evaluators' questions. The decision whether a final thesis conforms with defense requirements is formulated and the shortcomings that should be eliminated are noted in the records of the meeting.

The work cannot be further promoted for final defense procedure at the State Examinations Commission (VPK) or the Master Examinations Commission (MEK) if:

- its contents does not agree with the topic of the respective Bachelor or Master thesis;
- the research amount is not appropriate for achieving the set goal;
- it is obvious that the degree applicant will not manage to complete the thesis design by the set deadline.

After the pre-defense meeting, a student makes the required corrections, after which, not later than the date fixed by the LPTF Dean's order, he/she submits both an appropriately designed and **bound work** (one copy) to the VPK or MEK's responsible secretary. and its **electronic version** – to the LBTU IS (according to the procedure set by LBTU).

The supervisor(s) of a final thesis signs the title page confirming that the research has been completed. Also, the title page is signed by an advisor or advisors (if any has been officially approved).

For reviewing, the original copy of a thesis should be submitted. A Bachelor thesis is assigned to one reviewer recommended by the LF Methodical Commission and appointed by the Dean; a Master thesis is assigned to two reviewers. Reviewers can also make use of the thesis electronic version entered into the LBTU IS.

The reviewer's responsibility is to assess the work and submit a written review to the VPK/MEK secretary not later than three workdays prior to the defense date. The review should contain a substantiated thesis assessment basing on the points indicated in a review form (Appendix 10). If necessary, the reviewer may ask the author to explain and specify the thesis content if it benefits its objective assessment, as well as to present primary documentation.

The VPK or MEK secretary sends the review to the thesis author. **If the author and the supervisor do not agree with the reviewer's assessment**, consider it biased or violating the reviewing procedure or have other objections, then the author, in one day's time after receiving the review but not later than two days after the VPK or MEK secretary has received it, must submit a written complaint to the LPTF Dean with thorough explanation of the reasons for objecting. The Dean then organizes a repeated reviewing of a final thesis and assigns an additional reviewer. In such a case, all reviews are submitted to the Examination Commission and the reviewers are obliged to participate in the public defense of a final thesis to give their points of view in a discussion.

The LPTF Dean's Office prepares and makes available to public the time-schedule of the defense of final theses.

1.3.7. Defense of the thesis

The defense of Bachelor and Master theses may take place only after completing the full theoretical course of a respective study level.

Bachelor's and Master's degree applicants publicly defend their thesis in an open meeting of an Examination Commission (hereafter – Commission) which can be attended by all interested. Only the Commissions established in compliance with the LBTU Regulations and approved by the order of Rector have theses assessment rights. **Duration of a presentation should not exceed 10 minutes for a Bachelor thesis and 15 minutes for a Master thesis** (the Commission has the rights to interrupt a presentation if an applicant does not stay within the set time limit). During that time, the thesis author presents a convincing and well comprehensible information on the completed work making use of visual aids created in PowerPoint or other format. Instructions for thesis presentation are given in Chapter 3.

After the presentation, firstly, the Commission members and, afterwards, the listeners ask questions to the applicant. Answers should be short, concise and to the point. When all questions are answered, the Commission is publicly acquainted with the review(s). The degree applicant has to respond to reviewers' comments and explain whether he/she agrees or disagrees with the reviewers' assessment (see Chapter 3 for additional information). In case the thesis has been reviewed repeatedly, all reviewers read their reviews in the succession the reviews were produced.

After responding to all reviewers' comments, the discussion part begins. The members of the Commission as well as all listeners can express their opinion. The Commission head sets the succession of all listeners willing to speak and the allotted time limits. At the end of the discussion, the applicant answers all questions.

The Commission members assess the applicant's presentation, ability to respond to the questions and the reviewers' critical remarks, the arguments proposed in the discussion, and fill in their subjective assessment in a special form.

When all applicants have completed their presentations, then, in a closed meeting, the Commission members assess all final theses and make a decision about conferring a degree. The evaluation of the Bachelor and Master theses depends on the author's ability:

- to create an analytical literature review relevant to the theme, which substantiates the necessity for and topicality of the carried out research;
- to generalize, process and professionally interpret the obtained data;
- to draw conclusions;

- to carry out an individual work conforming with the respective thesis accomplishment and layout requirements;
- to publicly defend the thesis, answer the questions, and substantiate personal opinion and the conclusions drawn in a discussion;
- as well as on thesis assessment and the level of applicant's theoretic and practical qualification.

The decision of the Commission is final. If an applicant has well-founded objections regarding biased assessment of the thesis, the violation of the applicant's rights and reviewing procedure, then, until the end of the next working day after thesis defense, the applicant is eligible to submit an appeal in written form to the Head of the Commision, who then acts according to Chapter 5 of the LBTU Study Regulation.

After thesis defense, one copy of the final thesis together with a review (or reviews) remains at the institute where it was created; after 10 years, the theses authors are eligible to take back their works.

The best final study papers can be promoted for competitions and exhibitions.

The theses' authors are eligible to publish their research results. The copyright shared with all persons involved in thesis creation is regulated by mutual agreement and existing rules and regulations taking into consideration the LBTU Intellectual Property Management Guidelines (confirmed by LBTU Senate on 13.12.2017, decision No. 9-118).

2. THE LAYOUT OF A WRITTEN WORK

This chapter provides instructions for the elaboration of all types of written work the specifics of which is described in Chapter 1.

The majority of study work should be prepared on a computer. In certain cases to speed up the creation of a work, it can be handwritten. Students may write by hand:

- records of laboratory and practical work;
- written tests that are done at the presence of an academic staff member in a classroom;
- situationally – report of practical training if either they are prepared and submitted to an academic staff member on the same day when practical training is carried out or the information is entered into a previously created form;
- a specific graphic material concerning the data of practical training and final theses.

All other written work should be prepared on a computer.

In general, requirements for a **handwritten work** are the same as those for the electronic version of a thesis. Handwriting should be neat, intelligible, easily readable. Tables, figures and cartographic material should be accurately created.

2.1. Composition of the text, and the page layout

The work is typed on A4 (210×297 mm) pages using the Times New Roman font. An author may freely choose a **bold font**, l e t t e r s p a c i n g and underlining to highlight certain parts of the text. Scientific names of living organisms (plants, animals, microorganisms), in Latin, are *italicized*, but other symbols included in the name are written using a regular font, for example, *Faba vulgaris* Moech. or *Raphanus sativus* L. var. *oleiferus* Metzg. *Italicised* is also the text in a language other than English if it is inserted in the work.

Page setup: line spacing of 1.0 should be throughout the text, including tables and references; page margins – 25 mm at the top, bottom and right side, and 30 mm at the left side of a page; body text – justified. Font size in body text – 12 pt, in footnotes – 10 pt. Mark the beginning of the paragraph with an indent of 1.25 cm. Words in the text are not moved to a new line (not separated by a carriage sign).

All pages are numbered with 12 pt numbers on the right side of the bottom margin, at least 10 mm from the bottom edge; page number is not followed by a full stop. Title page is not numbered but included in the total numbering of pages.

Write numerals and unit[3], the initials and surname, and other compound designations that are not written separately, in the same row using single spacing between them or non-braking spaces (*press Ctrl+Shift+Space on keyboard*).

Be consistent when writing decimals, for example, use either 0.5 or ½. Also, use a decimal point (0.12) in decimals, not a comma.

Use an en dash ("–" or press *Ctrl+Dash key on the number pad*) to separate extra information or mark a break in a sentence using space on either side. To indicate a range of numbers, use an en dash without spaces (e.g., 5–9 cm). Use hyphens for compounds if it makes them clearer (e.g., barley-oats mix).

[3] An exception: there is no space between a numeral and a percent sign, for example, 10%.

The text is divided into chapters and subchapters at no lower than three-level headings using subordinate numbering in consecutive order. A separate subchapter should not be formed if it is shorter than one third of a page.

If a text should be structured in more detail, then either the first sentence or its part of the respective paragraph may be highlighted (e.g., in **bold**) or a heading introducing the paragraph and not separated from it may be formed and highlighted.

The chapter and subchapter headings should be concise and precise, centered, on the same page with the following text. Before the supplemental material, the title "APPENDICES" is written on a separate page, font size 12, capital letters, 3 pt spacing.

Each **Chapter** (Literture review; Research metodology; ect) starts on a new page; font size of headings – 14 pt, bold, capital letters with 3 pt spacing between them, centered.

Subchapters are a continuation of the text written on the same page. The text should be maximally distributed over the pages. A Subchapter should be started on a new page only if there is no space for the text of three lines under its heading. Font size for subchapter headings is 12 pt, sentence case, bold, centered. For second-level Subchapter headings: font size – 12 pt, left alignment, no indent.

Headings are not followed by a full stop and are not underlined. They are numbered with Arabic numerals and written in the same style as in the Contents part.

Use single-line spacing between headings, subheadings and the basic text, and double spacing between the basic text and the following chapter's/subchapter's heading.

Tables, figures and equations are inserted either in places they are mentioned in the text or after the next paragraph.

Explanations are written in footnotes which can be inserted and numbered automatically in Word (*References → Insert Footnote*). Abbreviations and designations when used for the first time are explained[4] either in the text or in footnotes.

The text should be written in good literary language, grammatically correct, compositionally and stylistically precise. A consistent and contemporary professional terminology should be used throughout the text – in the body part, Appendices, and Annotations.

The independent work must not contain tables and figures that are copied from other literature sources or the internet. If they are required to better illustrate the obtained research data, then the authors should design their own tables or figures based on the respective source and indicating a reference to the original work.

2.2. Tables

Numerical data are inserted into tables. Tables are numbered using Arabic numerals. The table number is written above the title of a table, right-side aligned, font size of the basic text. Tables are numerated separately for each chapter; therefore, the number of each table consists of two numerals followed by a full stop, for example, Table 2.3. which means "Table of Chapter 2, Subchapter 3". All tables should be referred to in the text. If there is only one Table in a work, it is not numerated but only the word "Table" is written.

Titles of tables are centered, bold, font size 12, not followed by a full stop. The table title should be concise, accurate, and refer to the research theme. The title should not be the copy of the heading of a respective Chapter/Subchapter. There is one-line spacing between

[4]An exception: standard measurement symbols.

the preceding text and the number of a table, between the title and the table, and between the table and the basic text following the table.

The width of a table should coincide with the width of a text, not exceeding the set margins. A table can be continued on the next pages, without repeating its title but with an indication, for example, "Table 3.2. (continued)" or "Table 3.2. (end)", right-side aligned. Column headings should be repeated on each page. If the text size in headings is too large, then columns can be numerated at the beginning of the table and the numeration is repeated on succeeding pages; in other cases, the numeration of columns is not required. Generally, a column heading containing "No." should not be added to a table, unless it is logically required in order to numerate indicators, parameters, or data. The first word in columns is capitalized and in subcolumns – written in lower-case.

Tables with less than three rows and columns should not be created; such data can be described in the text. The use of diagonal lines in tables is not admitted. Rows with numbers in columns are arranged in a vertical line. The same recording is preserved for the numerals of the same meaning (i.e., equal number of digits after the decimal point). If the same number or the same text is repeated down a column, it should be repeated, not substituted by inverted commas.

The cells in a table should not be left blank:

- use "–" if a certain phenomenon has not been observed;
- use "…" if a phenomenon exists but sufficient data are missing;
- use "×" if filling a cell is not logically possible or is not required.

If all parameters in a table have the same unit of measurement, it is written at the end of the title followed by a comma. In other cases, measuring units are written in the column and row headings. A separate column "Units of measurement" is not created, and the units of measurement are not written in cells together with numbers.

Font size in tables is the same as in the basic text – 12 pt. If a table contains a large amount of information, font size 11 or 10 may be used in the entire body of the table.

Tables are inserted as close as possible to their first mention in the basic text. Chapters should not start or end with a table. Tables are placed in such a way they can be read like the rest of the text; if they contain too much text, they are rotated clockwise so to be able to read the table.

The information in tables may be compiled in the form of a text or numbers, or both; most important is that it is clear, easily comprehensible and not misinterpretable. If tables with other authors' data are created, then the reference to the source should be given in parentheses at the end of the table title. Tables should be understandable by themselves, without reading the basic text; if designations or symbols are used, they are explained below the table. Examples are given in Appendix 11.

2.3. Figures

All kinds of illustrative material – pictures, charts, diagrams, drawings, maps, photographs, etc. – are figures. The illustrative material depicted in figures supplements the text, favours to and facilitates its understanding and comprehension. Figures should be appropriate to and consistent with the text, harmonically benefitting to its value, and they must not directly duplicate the information presented in tables. All figures should be referred to in the basic text.

Figures, just the same as tables, are numbered with Arabic numerals within each chapter separately. The first number followed by a full stop represents the number of the

respective chapter, and the second number followed by a full stop represents the number of the respective figure in that chapter. The abbreviation "Fig." should be used, for example, Fig. 2.1. which means "Figure 1 of Chapter 2". The figure number is followed by the title of a figure in the same row. Figure title should be concise and reflect the nature and essence of the information included in a figure. The number and the title of a figure are placed under the figure; font size 12 pt, centered (Fig. 2.1.).

The explanatory part of a figure (explanation of the symbols used in a figure) can either be placed in a figure or follow its title in the same or next row if it facilitates better comprehension of a figure; in latter case, the title of a figure is followed by a colon.

Technical layout of figures: photos are scanned or digitally placed into the text; drawings are created using Visio, Autocad, CorelDRAW or other analogous programmes; diagrams are created using Excel, SPSS or similar applications. For better readability, no background and frames are used in diagrams and no 3D images are created. Diagram gridline thickness – ¼; font size – 10–12 pt. Explanatory notes are not directly inserted in figures; instead, numbers and symbols are used and explained below the respective figure.

Figures are placed into text so they can be viewed without rotating the position of a work. If it is not possible, insert a figure so it has to be rotated clockwise. If figures are placed on a separate page, they should also be included in the total page numbering. References to figures, the same as for tables, may be incorporated into text or enclosed in parentheses, for example: "Data in Fig. 2.4. demonstrate that ….", "The arrangement of experimental plots is shown in Fig. 2.4.", or "Grain yield in treatment A was markedly higher than in treatment B (Fig. 2.4.)".

It is allowed to insert open access figures (photographs, maps, etc.) from the internet into the text, in which case a source reference – author and publication – should be made complying with copyright, for example, the geographical location of an experimental site on the map accessed over the internet, the photograph of a livestock farm (the equipment used in a technological process) where experiments were carried out and which was not taken by the author of the work, etc. Figures should be understandable without reading the basic text. Designations of treatments or parameters should be explained. Examples how to design a figure are given in Appendix 12.

It is not allowed to insert pictures copied from other person's work without the permission of the copyright owner (see Subchapter 2.7.).

2.4. Equations

Equations are written on a separate line, centered, using the *Equation* program or similar. Equations are numbered with Arabic numerals enclosed in parentheses, right-aligned, on the same line as the equation. The size of letters, figures and symbols – 12. Explanations of the symbols used in equations as well as their units of measurement are written below an equation, each on a separate line.

Examples:

$$NP_k = NP_b - NP_{pr} - NP_z, \quad (1)$$

where

NP_k – nitrogen and phosphorus mass in manure after their storage, kg per animal or animal place per year;

NP_b – nitrogen and phosphorus mass in the forage fed to animals, kg per animal per year;

NP_{pr} – amount of nitrogen and phosphorus that is transferred to animals and animal products, kg per animal per year;

NP_z – loss of nitrogen and phosphorus during manure production, handling and storage, % from total excreted amount.

$$\text{HTK} = \frac{\sum n \times 10}{\sum t_{>10}}, \quad (2)$$

where

HTK – hydrothermal coefficient;

$\sum n$ – sum of precipitation in respective time period, mm;

$\sum t$ – temperature, above 10°C, in respective time period, °C.

$$GDD = \Sigma \frac{(Tmax+Tmin)}{2} - Tbase, \quad (3)$$

where

GDD – growing degree days;

Tmax – maximum daily temperature;

Tmin – minimum daily temperature;

Tbase – base temperature.

2.5. Units of measurement

Base and derived SI units of physical quantities and their symbols should be used according to the Regulations of the LR Cabinet of Ministers (MK)[5]. If there are some exceptions, they should be explained in footnotes. Measurement abbreviations are used after the numerical values of physical quantities, in table headings, and in explanations to equations. In the basic text, measurement abbreviations and numerical values are written on the same line, unseparated, one-character spacing between them; the exception is the percent sign which is written without spacing (e.g., 25%).

Measurement symbols are not followed by a full stop (unless it marks the end of a sentence). Designations of all compound measurement units using negative exponents are written on the same line, for example, m s^{-1}, kg m^{-2}, t ha^{-1}. The derived units should be written in the same form throughout the paper, i.e., either in symbols or in full names, for example, t ha^{-1} or tons per hectare.

Making use of SI units, compound units can be derived and various parameters and processes can be characterized. For example, it is often advised to express the concentration of a substance in moles (mol kg^{-1}) or in the units of mass (g kg^{-1}) but not in percentage (%). Yield is usually expressed in tonnes or megagrams per hectare (t ha^{-1}, Mg ha^{-1}, where 1 t = 1 Mg), and fertiliser norm or rate is expressed in kilograms (fertiliser) or tonnes (manure, liming material) per hectare (kg ha^{-1}, t ha^{-1}). SI units and their derivatives are given in Appendix 13, and the comparison of measurement units is given in Appendix 16.

[5] *Mērvienību noteikumi:* MK noteikumi Nr. 1186. Stājās spēkā 29.10.2013.[Tiešsaiste] [skatīts 2020. g. 20. aug.]. Pieejams: https://likumi.lv/ta/id/261495-mervienibu-noteikumi. In Latvian.

2.6. In-text citations

After quoting or mentioning a certain literature or information source (findings, data, statements, opinions, conclusions, etc.), its author or the title of a resource and the publication year are written in parentheses, for example: (Bērziņš, 2012) or (Augsnes zinātne, 2008) etc.

If the cited publication has more than three authors, then only the first three surnames followed by *et al.* (or its equivalent in other languages, e.g., *u.c.* in Latvian, *und a*. in German) are given, for example: (Kāpostiņš, Ozoliņš, Zaķis u.c., 2012; Wang, Lee, Cao et al., 1999).

If there are no authors to a source, then only its title is cited, and, if it is long, then only the first two, three words followed by a three-dot ellipsis are written, for example: (Augsnes izpētes ..., 2008).

If an author's surname is mentioned directly in the text, a citation is inserted immediately after mentioning the author, for example, "D. Lapiņš and A. Bērziņš (2011) consider that…", or "According to K. Kāpostiņš and colleagues (Kāpostiņš, Ozoliņš, Zaķis u.c., 2012)…".

If authors are not named but the information, general statements or conclusions found in their publications are incorporated into the text, then the citation to the respective source or sources should be made at the end of a sentence or paragraph. For example: The amount and quality of yield depend both on the soil conditions and agrotechnics and on the distribution of precipitation and temperature in the vegetation period (Ozols, 1999; Ausmane, 2006; Lapiņš, 2008).

In-text citations in the same parentheses are written in chronological order depending on their publication year, starting with the oldest. If several sources are enclosed in parentheses, then they are separated by semicolons. When a reference is placed at the end of a sentence, a full stop marking the end of a sentence is placed after the closing parenthesis. If a particular reference is made to several publications of the same author in different years, then the surname is not repeated, for example: (Kārkliņš, 2009, 2012). If the same author (or authors) referred to in parentheses has several publications in the same year, then Latin alphabet letters are added to the publication year, for example: (Bankina, Gaile, Balodis u.c., 2012a, 2012b).

For sources referred to in another author's work, indicate "quoted from" in parentheses, for example, "As shown by Professor Jansons, ... (quoted from: Ozols, 2009)". If quotations are used, then they are placed in inverted commas and the respective citation page is included in parentheses, for example: (Ozols, 2008; p. 31). The citing of an unpublished material and opinions or thoughts is permissible only if reference to their author is made, for example, "Each missed day decreases the grain yield by ... (Prof. P. Ozoliņš, personal communication)". In such a case, the citation is not included in the Reference list.
There are two ways how to cite internet sources:

1. if information has been retrieved from a homapage lacking bibliographic data, then its full address is written in footnotes indicating the latest date the author has visited the site and made sure the address is valid. The access date should be possibly closer to the submission date of the final work. The adress should provide a direct access to the respective information source. Not listed in the References;
2. if an internet source has appropriate bibliographic data (author, the title of an article and a publication, publication year, etc.), then bibliographic description is arranged the same as for the references to other sources. Such reference is formed, for

example, for citing electronic versions of scientific articles, books and normative documentation. In this case, the internet adress is not written.

2.7. Bibliographic description of literature sources

References to literature sources should be precise and accurate so to be able to identify the used or quoted information source. For that purpose, bibliographic referencing standards are created. If another author's findings and ideas are made use of in a student's work, a reference to the original source should be made. If this is not done or is done incompletely or incorrectly thus rendering the thoughts and findings of other persons as one's own, then this is considered plagiarism which is illegal and has to be avoided in the creation of any kind of written work.

Different citation styles have different rules for in-text citations and the bibliographic description of information sources. A popular and commonly used referencing method in the world is the Harvard referencing style, which is convenient and easy-to-use for authors and easily understandable for readers. The present Instructions follow the Harvard style which should be consistently used when creating the bibliographic description of reports, essays, final theses, etc. References are formed basing on one – author/date — method for all kinds of information sources. The references referring to the particular part of a source should also include the page number. If several references have the same author(s) and year of publication, then a lower-case Latin alphabet letter should be added to the year both in in-text citation and in the Reference list.

All sources mentioned in the Reference list should be publicly accessible. If an unpublished material is referred to[6], for example, a report of a certain institution which is not distributed throughout the library network, then a reference is made at the bottom of the respective page – in footnotes. The titles of publications are written in the original language. The title of the basic document should be written in full, exactly as it appears in the title page; it should not be modified or abbreviated and is italicized. In the further description, abbreviations may be used, for example, inst. – institution; ed. – editor, etc.

Unpublished material or the internet sources without all respective bibliographic data should be referred to in footnotes. Footnotes are listed at the bottom of the page on which a reference is made using automatic insertion (Insert footnote) and numbering in the Word Document. If the same information source repeatedly appears in different places on the same page, the respective number is entered manually as a superscript.

All references to the used sources should appear in the Reference list, and vice versa – all sources listed in the References should be referred to in the written work.

The Reference list is arranged alphabetically – firstly, sources in the languages of Latin alphabet and, afterwards, the languages of Cyrillic or other alphabets. All entries in the Reference list are numbered consecutively regardless of their language.

The structure of bibliographic references consists of certain elements. Below follows a brief explanation of these elements and the guidance how to arrange them.

1. **Main responsibility** – person(s) or institution(s) responsible for the contents and production of an information source (book, journal, article, homepage, etc.). In case a particular document includes several works by different authors or has more than

[6] Unpublished materials are: analytical reviews, reports on technical or scientific research, deposited scientific work, programmes or materials of a congress/conference, and other documentation.

three individual or collective authors, the main responsibility may be held by its compiler, chief editor or other responsible person distinctly indicated in the source.

2. **Year** – the year of making the information available to public. Regardless of the form the publication year is written in the source, in the bibliographic entry it should be given using Arabic numerals. If publication year is not known, then substitute it with the abbreviation [s.a.] (from Latin *sine anno*).
3. **Title** – a word, a word combination, or a group of signs indicated in a document which helps identify it and makes it distinctive from other works. If a title consists of the general title and a subordinate heading, then they are separated by a full stop and a space. The title can be supplemented by an additional information (an address, type of a publication, genre, activity, etc.) that is subordinate to it, in which case the additional information is separated from the title by a colon and a space and begins with a lowercase letter unless spelling rules require a capital letter.
4. **Subordinate responsibility** – persons and institutions not holding primary responsibility in the publication of a work but have made another, subordinated contribution (for example, editors, compilers, translators). Persons' names are written in the form and order they are given in the source.
5. **Title of a periodical or its part** – the title and the issue of a serial publication (newspaper, journal, annual, etc.). A month or a date should be given if indicated in a source. Different terms can be used to designate the issue of a periodical (No, Vol., Iss., etc.). If the bibliographic description is made for the complete set of a certain serial publication, then indicate only the first and the last number.
6. **Publication** – the title of the publication (monograph, scientific article, annual, etc.) containing the respective article.
7. **Place of publication** – the place where the work has been published. If there are several places, then either the first one is written or all places the same way they are mentioned in the source, separating them with a semicolon and a space. If there is no publication place, then it is omitted or substituted with a Latin abbreviation in square brackets – [s.l.] (from Latin *since loco*).
8. **Publisher** – a person or an institution that has published the respective work; the reference is made the same way the place is written in the source but omitting such words as "publishing company", "Ltd", etc. unless they are part of a publisher's name. If there are several publishers, then either only the first one is written or all publishers are mentioned – in the order they are named in the source, separating them with a semicolon and a space.
9. **Amount** – total number of pages (for monographic works) or the pages of a certain work (part of a larger publication). For materials not having the format of a written text, the amount is expressed in the number of physical units, for example, "two CDs".
10. **Other information** – other relevant information, for example, for electronic sources – the date they were viewed.

According to Harvard system, a bibliographic reference is created as follows:

Main responsibility. (Year of publication). Title: subordinate responsibility. The title of a periodical or its part. Edition. The place of publication: publisher. Amount. Other relevant information.

Further follow explanations with examples for creating bibliographic references to different information sources.

Monographic publication – consists of one part, a completed or intended to be a completed work. When referencing, the total number of pages is indicated.
Examples:

One author

Boruks A. (2003). *Zemnieks, zeme un zemkopība Latvijā*. Latvijas Lauksaimniecības universitāte. 2. pārstr. un pap. izdevums. Jelgava: LLU. 717 lpp.

Abrol D. P. (2012). *Pollination Biology: Biodiversity Conservation and Agricultural Production*. Springer Netherlands. 792 p.

Two or three authors

Saktiņa D., Meyers H.W. (2005). *Eiropas Savienības līdzfinansētās un nacionālās lauku atbalsta programmas Latvijā: gatavojoties jaunam programmēšanas periodam*. Rīga: Latvijas Valsts agrārās ekonomikas institūts. 242 lpp.

McQueen R. A., Knussen C. (2006). *An introduction to research methods and statistics in psychology*. Harlow: Pearson Prentice Hall.437 p

Wyk B.E., Wink M. (2004). *Medicinal Plants of the World*. Portland: Timber Press. 480 p.

A group of authors. Books with more than three authors (a group of authors). Write the first three and substitute the rest of the names with: *u.c*. in Latvian, *et al*. in English, *a*. in German, or *u др*. in Russian. Author names as mentioned in the source follow the title of a book: an initial first, then – a surname.

Ģeoloģija, augsne, agroķīmija (2008): metodiskie norādījumi mācību praksei. 2. pārstr. un papild. izd. A. Kārkliņš, I. Līpenīte, I. Lūse u.c. Jelgava: LLU. 88 lpp.

Corporate or group author, compiler. An organisation or a person who has summarised collective opinions or activities, for example, reviews, catalogues, etc.

Latvijas statistikas gadagrāmata 2007 (2008). Atb. par izd. D. Brīdaka, LR CSP. Rīga: LR Centrālā statistikas pārvalde. 564 lpp.

Wheat end uses around the world (1995). Ed. by H. Faridi, J. M.Faubion. St.Paul, Minnesota: American Association of Cereal Chemists. 292 p.

Ecosystem Consequences of Soil Warming: Microbes, Vegetation, Fauna and Soil Biogeochemistry (2019). Ed. by J. E. Mohan. Xx: Academic Press. 592 p.

No author. With neither individual nor corporate author; write the title of the source in missing author's position.

Zinātnes un tehnoloģijas vārdnīca (2001). Galv. red. D. Guļevska. Rīga: Norden AB. 754 lpp.

Webster's basic English dictionary. (2000). Springfield, MA: Merriam-Webster.

Medicine in old age (1985). 2nd Edition. London: British Medical Association.

Concise Oxford English dictionary (2011). 12th edn. New York: Oxford University Press.

Part of a monographic publication

Parts of a monographic publication are separated from other elements of the basic text using "***No:***" in Latvian, "***In:***" in English and German, in **bold** and *italicized*.

Examples:

Granstedt A. (2012). The fundaments of ecological balance. ***In:*** *Farming for the future – with a focus on the Baltic Sea Region*. BERAS implementation reports No. 2, p. 10–23.

Latvijas lauksaimniecības kamera (1938). ***No:*** *Lauksaimniecības leksikons.* Red. J. Apsīts. 2. sēj. Rīga: Zelta grauds, 1190.–1196. lpp.

Part of a book, for example, a book including separate writings of several authors. The range of respective pages is indicated as follows: lpp. in Latvian, p. in English, S. in German, c. in Russian.

Examples:

Benton Jr.J. (2004). Soil and Hydroponics. ***In:*** Benton Jr.J. *Hydroponics. A Practical Guide for the Soilless Grower.* Boca Raton, Fla.: CRC Press, p. 15–18.

Paršova V. (2001). Valsts kadastra realizācija Latvijā. ***No:*** *Zemes izmantošana un kadastrs Latvijā.* A. Boruka red. Rīga: Skrīveru zin. centrs: VZD, 313.–365. lpp.

Part of a serial publication

Serial publication – printed or other types of publications issued in successive parts, at fixed intervals, usually with chronologic numbering: periodicals (newspapers, journals, magazines), annuals, proceedings, calendars, etc. Contrary to the description of the parts of monographic publications, the indication "*In:*" is not used. The number (or volume, issue, etc.) of the publication and the range of pages are separated by a comma.

Examples:

Daugavietis M., Korica A., Polis O., Bartkevičs V. (2008). Skujkoku zaleņa piesārņojums ar pesticīdiem un smagajiem metāliem. *Latvijas Lauksaimniecības universitātes Raksti,* Nr. 20 (315), 128.–135. lpp.

Sebestyén Z., Lezsovits F., Jakab E., Várhegyi G. (2012). Correlation between heating values and thermogravimetric data of sewage sludge, herbaceous crops and wood samples. *Journal of Thermal Analysis and Calorimetry*, Vol. 110(3), p. 1501–1509

Znotiņa V. (2003). Epiphytic bryophytes and lichens in boreal and northern temperate forests. *Proceedings of the Latvian Academy of Sciences*. Section B: Natural, Exact and Applied Sciences, Vol. 57, No. 1/1, p. 1–10.

Cartographic material

References are made according to the principles of referencing monographic publications.

Examples:

3231 Kursīši (2002): Latvijas Republikas topogrāfiskā karte mērogā 1:50 000. Rīga: LR Valsts zemes dienesta Kartogrāfijas pārvalde. 1 lpp.

Bauskas rajons (2005): rajona karte mērogā 1:100 000. Rīga: Karšu izdevniecība Jāņa sēta. 1 lpp.

Documents of conferences, congresses, symposiums, etc.

Bibliographic references for the reports or other material of conferences, congresses, symposiums, etc. are created according to the principles of referencing the parts of monographic publications.

Examples:

Bankina B., Bimšteine G., Katamadze A. Kreita D. (2016). Lauka pupu slimības un to ierobežošanas efektivitāte. ***No**: Līdzsvarota lauksaimniecība*, Zinātniski praktiskās konferences raksti (2016. g. 25.–26. febr.). Jelgava: LLU, 12.–17. lpp.

Zeipiņa S., Alsiņa I., Lepse L. (2015). Influence of agroecological factors on artichoke yield and quality: review. ***In:** Research for Rural Development 2015*, Annual 21st International Scientific Conference Proceedings (13–15 May, 2015), Vol.1. Jelgava: LLU, p. 77–81.

Patent documents

Patent – an exclusive right granted for a novel, industrially applicable invention. Referencing scheme: Name of a state or international organisation. Main responibility. *Title of patent*: the type of a document. Subordinated responsibility. Document number. The date of application or publication. Notes.

Example:

M plus K. *Bakteriālais sastāvs ūdens un augsnes attīrīšanai no naftas piesārņojuma un metode tā producēšanai.* L. Baburins, A. Muškevičs, G. Baranovs (izgudrotāji). Int. CL.: CO2F3/34. Iesniegšanas datējums 1998-05-26. Patenti un preču zīmes. LV12348B. 2000-01-20.

Unpublished material

Bibliographic references to unpublished material are created the same way as those for monographic publications. Bachelor, Master, Doctoral or PhD theses and dissertations are the most often utilized unpublished material. Their copies are kept in the establishment where the theses were created and/or defended (which is mentioned in the bibliographic description). Doctoral or PhD theses and dissertations are also kept in central libraries; therefore, they can be included in the Reference list. Other types of unpublished material are reference materials, documents, reports of different institutions, etc. which are not included in the Reference list but are referred to in footnotes.

Examples:

Malceniece E.I. (2020). *Yield and quality of coloured carrots on the farm "Bračas":* Bachelor thesis. Latvia University of Life Sciences and Technologies. Jelgava, LLU. 60 p.

Šalkovska L. (2021). *Incidence of wheat common bunt depending on variety, and the efficacy of wheat seed treatment with biological plant protection products*: Master Thesis. Latvia University of Life Sciences and Technologies. Jelgava, LLU. 68 p.

Electronic resources

When creating written study assignments, students may use the information available in electronic resources which has no author, no title, and no other relevant bibliographic information; in such a case, the reference is made in footnotes. To describe electronic resources, use "*In:*" or its equivalent in other languages, in bold. The title of the basic document is italicised.

Example:

Shaw B.T., Ekstrom G.F., Campbell J.R., Preuschen G., Curtis S.E., Palmer R.A. (2019). Agricultural Sciences. ***In:*** *Encyclopaedia Britannica*. Encyclopaedia Britannica, Inc. [Online] [viewed August 25, 2020]. Available: https://www.britannica.com/science/agricultural-sciences.

Electronic database – a collection of data or information that is specially organized and stored for rapid retrieval by a computer. Authors may use an entire database or its part.
Examples:

Herd register. ***No****: Agricultural Data Centre* [Online] [viewed December 20, 2021]. Available: https://registri.ldc.gov.lv/en/?lang=en

Lauksaimniecība, mežsaimniecība un zivsaimniecība. Augkopība. ***No***: *LR Centrālās statistikas pārvaldes datubāzes*. [Tiešsaiste] [skatīts 2020. g. 24. aug.]. Pieejams: http://data1.csb.gov.lv/pxweb/lv/lauks/lauks__03Augk__ikgad/?tablelist=true

Sown area, harvested production and average yield. ***In:*** *Central Statistical Bureau Statistical database* [Online] [viewed September 20, 2021]. Available: https://stat.gov.lv/en/statistics-themes/business-sectors/agriculture/2789-sown-area-harvested-production-and-average

Pieejamā bioloģiskās lauksaimniecības veģetatīvās pavairošanas materiāla datu bāze. ***No****: Valsts augu aizsardzības dienests*. [Tiešsaiste] [skatīts 2020. g. 2. dec.]. Pieejams: http://www.vaad.gov.lv/sakums/registri/biologiska-lauksaimnieciba/datu-baze-par-pieejamo-vegetativo-pavairojamo-materialu.aspx

The list of References is placed on a new page (Appendix 14). Examples on how to write bibliographic references are given in Appendix 15.

2.8. Appendices

Supplementary material is arranged as the continuation of the basic text. It comprises different initial data, calculations and calculation methods as well as other significant material characterising or supplementing in more detail the findings described in the basic text. It has to be noted that there is no necessity to create appendices containing insignificant information which does not rouse the reader's interest. Such are, for example, the printouts of raw data from mathematical statistics of obtained measurements, booklets, etc. which should be stored in a primary-documentation folder (see Subchapter 1.4.4.).

Also, it is useful to create a separate appendix with a table summarising the criteria for data statistical processing and containing the parameters generated by the applied software and considered by the author as significant for the interpretation of the obtained research results.

Supplementary part is placed after the Reference list and is separated from it by a blank page with the title "APPENDICES" on it, capital letters, centered. Each appendix begins on a new page and is numbered consecutively on the upper right corner of a page, for example, Appendix 1, Appendix 2, etc.

If tables and calculations require more space, they are continued on the next page(s) writing, for example, "Appendix 15 (continued)" on the upper right corner; if a table or other material ends on a certain page, then, for example, "Appendix 15 (end)" is written.

Each appendix has a title describing its contents. Appendices should be referred to in the basic text by writing an abbreviation of the word "Appendix" in parentheses, for example: (App. 5), (Apps 3–7). The pages of supplemental material are numbered consecutively as a continuation of the basic text; however, they are not included in the total page numbering.

All layout requirements for Appendices are the same as for the basic text as described in Chapter 2.

3. INSTRUCTIONS FOR THE PRESENTATION OF A WORK

Mastering good communication skills – both written and verbal – is an important task for students. The ability of expressing, explaining and defending one's own opinion is essential in professional activities. Both these skills should be learned and developed simultaneously; therefore, students should publicly speak at seminars, defend their laboratory and practical work reports, take part at scientific conferences, and present and defend their final theses. The aim of these activities is to develop and master students' communication skills in all levels of the study process.

There are two types of presentations: an oral presentation and a poster presentation. These Instructions refer only to oral reports created for presenting the study work planned in a study plan. Posters are usually created to present the findings of a research work; they also contain elements of an oral report.

A presentation embraces two equally important parts: a report and visual aids. A report presents and defends an idea, the accomplished work, whereas visual aids illustrate them. Therefore, they should supplement each other, be harmoniously and logically interlinked, and attract the audience's atttention at the right moment.

Report. At the defense of a study work, the time limit for one speaker does not usually exceed 10–15 minutes. This is set in advance by the academic staff member who organises the assessment process. Therefore, when preparing a report, a student must acurately plan the presentation time so to be able to manage:

- to acquaint the audience with all most significant aspects of the work: topicality, the objective and tasks, methodologies applied, conditions, results obtained, conclusions, recommendations, etc.;
- to draw and maintain the audience's attention;
- to persuade the listeners about the topicality of the work, its professionalism, correctness and the student's own contribution in its creation;
- to demonstrate personal competence in all issues (also subordinated ones) connected with the work.

The report should be delivered fluently, successively, with confidence, in a clear and natural voice. Students should be mindful of their body language, have natural gestures, and choose a good posture so to have an eye contact with the audience and an easy access to visual aids. It is important to make sure that both the demonstration of visual aids and the commenting on the relevant information take place simultaneously. The presentation of a report should be practiced aloud repeatedly before delivering it in front of an audience.

It is useful to write down the full text of an oral presentation; however, for the day of a presentation it is advisable to prepare a concise plan with short statements and the most important data using clearly visible letters and highlights in order to easily read the information if necessary. If the main information is written on visual aids, then it is more convenient for a speaker to comment on it.

As a presentation must not exceed the set time limit, the speaker has to control it and, if needed, make timely corrections. If a defense supervisor interrupts the presentation, it may cause confusion and the most important part of a report – conclusions – may be left unsaid. The words "Thank you for your attention!" will undoubtedly mark the end of a presentation.

The presentaton of a **final thesis** (Bachelor's, Master's) should be particularly meticulously approached as it encompasses a huge work accomplished by a student and

reflects the professional maturity and appropreatiness for being granted a certain diploma. The analysis of research findings should be constructive and well-grounded. If a thesis deals with experiments, then it should have sufficient data statistical processing criteria as well as economic justification or other arguments that can confirm the objectiveness of the carried out research. Conclusions and recommendations should be based solely on the outcomes of an experiment or a project; they are not subjective or emotional statements or a narrative review of the literature. It is advisable to take into consideration a reviewer's objections and incorporate them into the thesis' presentation speech and/or in the layout of visual aids. After demonstrating the final slide, a student may add additional slides that contain answers to important objections or questions of a reviewer if they were not dealt with during the presentation. The additional slides should be demonstrated just after reading the review.

Visual aids are all materials that are demonstrated to the audience during thesis presentation and that complement the speaker's narration. They include multimedia projectors, video, natural exhibits (plants, their parts, fruit, etc.), software, and other materials. Prior to presentation, students should make sure about the availability of technical equipment and the possibility of demonstrating their visual aids (e.g., the appearance of a PowerPoint presentation on a screen in the respective room, the performance of a presentation on the respective computer, demonstration of videorecords, etc.).

Instructions for using the visual aids:

- they should be clearly seen by the audience;
- the listeners should be able to understand the presented information (at least generally) without the speaker's explanations;
- they should be used in tight concert with oral presentation;
- each element of visual aids should be displayed long enough for the audience to better understand the information they hear;
- they should be available throughout the entire presentation time;
- they should be qualitatively and correctly designed.

Presentation software programmes that are most often used are multimedia applications (*PowerPoint, Prezi*, etc.). The main criteria for creating visual aids:

- do not overload the slides with information; the size of a projected table – no more than 30 numbers;
- use a font size that is easy to read – at least 20 pt for basic text; effective presentation requires at least 24 pt;
- a brief heading for each slide;
- number the slides so they can be repeatedly viewed if needed;
- include essential information, for example, add data significance criteria to the table containing the results of an experiment;
- do not use too much animation and the font colours that are too bright or distracting;
- be sure that the number of slides corresponds to the duration of a presentation.

After a presentation, evaluators and the rest of the audience ask questions and the speaker provides answers. The subject-matter and the amount of questions not only may reflect the engagement and interest of the audience, willingness to learn in more detail about the presented topic and to get to know the speaker's point of view on other relevant issues, but also may show that the presentation has not brought enough clarity concerning the research theme, the mistakes or inaccuracies have been noticed, some essential information has not been said, etc. One way or the other, the further process of the presentation depends on the correctness and completeness of the speaker's responses.

The following should be taken into consideration:

- in due time and carefully prepare answers to the already known reviewer's comments made in the review;
- a particular question is not quite clear (too lengthy, indistinct), you can ask to repeat it. However, keep in mind that evaluators may consider you do not understand the core of the question if the rest of the audience have understood it;
- for answering, if necessary, you can make use of the materials you have, but be operative and not make the audience wait too long thus leaving a negative impression of your competence;
- all questions and critical remarks – those in reviews and during presentation – should be answered. If a correct answer cannot be provided, you may respond diplomatically, for example: excuse me, I did not pay attention to it; obviously I have not been precise at that point; unfortunately, at this moment I cannot respond to your question; I agree, that should have been done differently, etc. However, such phrases should be used only in exceptional cases. Diplomatic responses create an impression the speaker lacks competence and has weak knowledge of his/her research topic;
- use professional terms, phrases, explanations;
- responses should be concise and to-the-point; do not start explaining things you have not been asked as that will also produce an impression of not having enough knowledge about the subject-matter of the question;
- be sure to provide polite answers. Support your viewpoint, data, or information sources if they differ from those of a questioner, avoid showing emotions, and back up your arguments convincingly but considerately, not offending or disturbing the audience.

Presentation of a thesis plays an important role in the assessment of a completed study work which ends with its public or individual presentation and defense. The presentation can markedly improve or lower the general evaluation of a study work. Therefore, thorough creation of reports and visual aids, studying of the reviewer's critical remarks, and elimination of the knowledge gaps on a particular subject are the preconditions for a successful evaluation outcome. At the final presentation, students demonstrate the respective skills they have practiced during the study process. Therefore, practice your presentation skills before an audience repeatedly, simultaneously making sure you stay within the set time limits.

A P P E N D I C E S

Appendix 1

LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF AGRICULTURE

CAPITAL LETTERS, font size 14 pt,

J H O N E A G L E

CAPITAL LETTERS, font size 14 pt, bold, spacing 3 pt, centered

PLANT NUTRIENT REQUIREMENT FOR WINTER WHEAT

CAPITAL LETTERS, font size 14 pt, bold, spacing 16 pt, centered

Independent work in the study course "Soil Fertility and Fertilizers"

Font size 14 pt, centered

Author: 3rd year student of LF academic
Bachelor study programme "Sustainable Agriculture" J. Eagle, matr. No. LF20001

Font size 12 pt, left aligned

Submitted:

Presented:

Evaluation:

Jelgava 2023

Font size 14 pt, centered

Appendix 2

LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF AGRICULTURE

APPROVED BY

Director of academic Bachelor[7] study programme "Sustainable Agriculture" J. Kaņeps
date

THE ASSIGNMENT OF A BACHELOR[7] THESIS

Author: **Jhon Eagle**
The theme of the work **Plant nutrient losses due to the leaching from soil**
Augu barības vielu zudumi augsnes izskalošanās dēļ

Annotation
(*A detailed and specified description of the assignment, its topicality,objectives and tasks, place and scope of experiments, applicable methods, data processing methods, and assessment of the results. The amount of Annotation – at least 1300 characters*).

Completion Deadline:	Year, month, day	
Author:	J. Ealge, matr. No. LF21009	……..……..…… (signature, date)
Supervisor(s):	N. Surname, Dr. agr., Prof.	……..……..…. (signature, date)
Advisor:	N. Surname, Dr. agr., Leading Researcher	……..….....… (signature, date)

The subject of the thesis has been approved by the Dean of the Faculty (order No. ..……).

[7] An analogous description for a Master thesis. Fill in the name and surname of the director of the programme

Appendix 3

Guidelines for the compilation of research primary documents

1. **A short experimentation programme**, a working hypothesis.

2. **Experimentation scheme** – the list and layout of research variants.

3. **Characteristics of experimental site and conditions** – describe the place (farm, animal housing, laboratory, etc.), conditions (soil, its characteristics, microclimate, etc.), the basic materials used for the experiment, their provision, etc.

4. **List of the main tasks and observations.** Chronologically list the tasks and observations that should be carried out to accomplish the experimentation programme. Indicate the applicable method, amount of work, deadlines, and other important conditions to complete the assigned tasks methodically correctly.

5. **The carried out tasks and observations.** Successively register the results of carried out assignments, recordings, measurements, analyses and observations. Register as detailed as possible the time, conditions, rates of applied materials (chemicals), the used machinery and tools, methods, as well as deviations from the planned methodology. The results obtained should be presented in the form of tables.

6. **Calculations.** Provide calculations of the rates (doses) of materials (chemicals) used in experimental variants. Perform data processing: convert the comparable parameters into numerical values and units of measurements in the form that afterwards is included in a final thesis. Provide primary documents of the biometric data processing of experimental results. Present the basic data and calculations for economic assessment.

Appendix 4

LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF AGRICULTURE AND FOOD TEHNOLOGY

CAPITAL LETTERS, font size 14 pt, centered

CAPITAL LETTERS, font size 14 pt, bold, spacing 3 pt, centered

D A I G A B Ē R Z I Ņ A

POSSIBILITIES FOR THE DEVELOPMENT OF ORGANIC FARMING ON THE PRIVATE FARM "OZOLKALNI"

CAPITAL LETTERS, font size 14 pt, bold, spacing 16 pt,

Thesis for the Bachelor's degree in Sustainable Agriculture[8]

Font size 14 pt, centered

Author: ..... D. Bērziņa, LF20001
(signature, date)

Font size 14 pt, left aligned

Scientific supervisor ..……...…… B. Ozoliņa, Mg. agr., Lecturer
(signature, date)

Jelgava 2023

Font size 14 pt, centered

[8] Thesis for the Master's degree.

Appendix 5

A N O T Ā C I J A

Ozola A. (2023). ***Ziemas kviešu ražas veidošanās atkarībā no fungicīdu pielietošanas*:** zinātniskais darbs lauksaimniecības zinātņu bakalaura grāda lauksaimniecībā ieguvei. Latvijas Biozinātņu un tehnoloģiju universitāte. Jelgava, LBTU. 55 lpp.

Kvieši *(Triticum)* ir trešais nozīmīgais kultūraugs pasaulē, pēc to iegūtā ražas apjoma un visplašāk audzētā graudaugu suga Latvijā. Līdz ar pieaugošo pārtikas vajadzību pasaulē, nepieciešams iegūt augstākas kviešu ražas. Risinājums tiek meklēts selekcionējot intensīvākas šķirnes un ierobežojot kaitīgos organismus, piem. lapu slimības.

Darba mērķis bija izvērtēt un salīdzināt trīs ziemas kviešu šķirņu graudu ražu, ražas struktūrelementus un kvalitāti raksturojošus rādītājus atkarībā no lietotā fungicīda. Pētījums veikts 2019./2020. gadā LLU mācību un pētījumu saimniecībā „Vecauce". Pētījumā veikta divfaktoru analīze (A – šķirne, B – fungicīdu lietošanas shēma), kurā vērtētas trīs ziemas kviešu šķirnes ('Edvins', 'Skagen' un 'Olivin'), pielietojot sešas dažādas fungicīdu lietošanas shēmas, salīdzinot ar kontroles variantu bez fungicīdu smidzinājuma, kopā 21 variants četros atkārtojumos. Vērtēta fenoloģisko fāžu iestāšanās: sadīgšana (11. AE), vārpošana (51. AE) un novākšanas gatavība (90.–92. AE). Izmēģinājumā veiktie vērtējumi un uzskaites: noteikta laukdīdzība un ziemcietība, vērtēta lapu slimību attīstība četros ziemas kviešu attīstības etapos, noteikts lapu zaļais laukums piengatavības fāzē, mērīts augu garums, noteikta izturība pret veldri, produktīvo stiebru skaits 1 m^2, noteikts graudu skaits vārpā, veiktas graudu kvalitātes analīzes: noteikts proteīna, lipekļa un cietes saturs (%), Zeleny indekss un tilpummasa (kg hL^{-1}), krišanas skaitlis (s) un 1000 graudu masa (g). Datu matemātiskai apstrādei izmantotas dispersijas, korelācijas un regresijas analīžu metodes.

Ziemas kviešu augšana un attīstība bija atkarīga no šķirnes īpašībām un izmēģinājuma gada meteoroloģiskajiem apstākļiem. Izmēģinājumā tika novērota matemātiski būtiska ($p<0.05$) fungicīdu ietekme uz ziemas kviešu ražas apjomu, 1000 graudu masu, krišanas skaitli un lapu zaļo laukumu piengatavības fāzē. Gandrīz visi vērtētie rādītāji bija atkarīgi no izmantotās šķirnes, izņemot laukdīdzību un Zeleny indeksu, ko nebija ietekmējis neviens no pētāmajiem faktoriem.

Ziemas kviešu ražas apjoms 2015. gadā bija augsts – vidēji starp visiem variantiem 11.73 t ha^{-1}. Augstāko ražas līmeni sasniedza šķirne 'Skagen' (maksimāli – 12.9 t ha^{-1}, vidēji – 12.1 t ha^{-1}), kura pētījuma laikā sasniedza vidējās vērtības ražas struktūrelementu rādītājiem. Salīdzinot ražu atkarībā no fungicīdu lietošanas shēmas, būtiski augstāku ražu uzrādīja shēmas, kurās 31. AE veikta apstrāde ar fungicīdu Capalo un 49. AE ar strobilurīnu saturošu fungicīdu. Pētījumā apstiprinājās, ka fungicīdu smidzinājumam ir ietekme uz augstākas 1000 graudu masas (g) veidošanu un krišanas skaitļa vērtības (s) pazemināšanu, salīdzinot ar kontroles variantu. Pētījuma laikā izmēģinājumā konstatētas trīs lapu slimības, kuru attīstība kopumā bija zema. Kā dominējošā slimība izpaudās kviešu lapu pelēkplankumainība (*Zymoseptoria tritici*).

Fungicīdu pielietošanas nepieciešamības izvērtēšanai uz dažādu ziemas kviešu šķirņu ražas veidošanos ir būtiska nozīme kviešu audzēšanā un integrētā augu aizsardzībā.

Tab. 23, att. 21, bibl. 82 nos., pielik. 5.

Appendix 6

S U M M A R Y

Ozola A. (2023). ***Formation of winter wheat yield depending on application of fungicides:*** Bachelor Thesis[9]. Latvia University of Life Sciences and Technologies. Jelgava, LBTU. 55 p.

Wheat (*Triticum*) is the third most important crop in the world by the total yield and the most widely grown cereal in Latvia. The increasing demand for food in the world also forces the research to obtain higher wheat yields. A solution could be a choice of improved varieties and a control of harmful organisms, e.g., leaf diseases.

The aim of the Thesis was to evaluate the formation of winter wheat (*Triticum aestivum*) yield, yield components and quality indicators depending on variety and fungicide application. Field trial was carried out at the Research and Study farm "Vecauce" in 2019/2020. A two-factor (factor A – variety; factor B – fungicide treatment scheme) field trial was arranged. Three winter wheat varieties ('Edvin', 'Skagen' and 'Olivin') were evaluated applying six different fungicide treatments and a control treatment without fungicide sprays. Totally, 21 variants were included. Phenological phases (full emergence (GS 11), heading (GS 51) and ripening (GS 91–92)) were evaluated; different other assessments and measurements were also done during the research: field germination (%), winter hardiness (points), disease development at four plant growth stages, and green leaf area (%) at GS 73. Plant height (cm), lodging resistance (in points), and yield components – number of spikes per m^2, spike length (cm), and the number of grains per spike – were also measured in the trial. Grain quality was analysed: crude protein, gluten and starch content (%), Zeleny index, volume weight (kg hL^{-1}), Hagberg falling number (s) and 1000 grain weight (g). Analysis of variance, correlation and regression methods were used for data processing.

Growth and development of winter wheat depended on the characteristics of variety and favourable meteorological conditions. Wheat yield, 1000 grain weight, falling number and green leaf area at the GS 73 were significantly ($p < 0.05$) affected by fungicide application. Almost all measured indicators were affected by the used variety, except field germination and Zeleny index, which had not been affected by any investigated factor.

The winter wheat yield level was high in 2015, on average – 11.73 t ha^{-1}. The variety 'Skagen' (max 12.9 t ha^{-1}, on average – 12.1 t ha^{-1}) produced the highest yield despite the fact that the values of yield components for 'Skagen' were only medium. Significantly higher yields depending on fungicide application if compared to control showed the schemes with two fungicide applications: Capalo at GS 31, and strobilurine-containing fungicide at GS 49. The study confirmed that fungicide sprays have an impact on the formation of a higher 1000 grain weight and reduced falling number values. During the research, three leaf diseases were detected, and the development of diseases was low. The dominant disease was septoria leaf blotch (*Zymoseptoria tritici*).

Evaluation of different fungicide application schemes, their necessity and influence on the yield formation of several wheat varieties has a significant importance for further development of an integrated crop management.

[9] For the Master degree programme: Master Thesis.

Appendix 7

For experimental work

C O N T E N T S

Appendix 7 (end)

Literature review

C O N T E N T S

Appendix 8

Short Annotation in Latvian and in English

Anotācija latviešu valodā

(līdz 850 rakstzīmēm ieskaitot atstarpes)

Divfaktoru izmēģinājums tika iekārtots 2019./2020. gadā LLU MPS "Vecauce". Faktors A ietvēra trīs ziemas kviešu šķirnes ('Edvins', 'Skagen', 'Olivin'), bet faktors B – sešas fungicīdu lietojuma shēmas un kontroles variantu. Pētījuma mērķis bija izvērtēt un salīdzināt ziemas kviešu šķirņu graudu ražu, ražas struktūrelementus un kvalitātes rādītājus atkarībā no lietotā fungicīda. Fungicīdu ietekme novērota uz ražas apjomu, 1000 graudu masu, krišanas skaitli un lapu zaļo laukumu. Šķirnes faktors ietekmēja gandrīz visus rādītājus. Ziemas kviešu ražas apjoms bija augsts – vidēji 11.73 t ha^{-1}. Augstāko ražu deva šķirne 'Skagen' un fungicīdu shēmas, kurās veikta apstrāde ar fungicīdiem 31. un 49. AE (iekļaujot smidzinājumu ar strobilurīniem). Pētījumā konstatētas trīs lapu slimības, kuru attīstība bija zema.

Short Annotation in English

(up to 850 characters with spaces)

A two-factor field trial was carried out at the RSF "Vecauce" in 2019/2020. Factor A included three winter wheat varieties ('Edvins', 'Skagen', 'Olivin'), but factor B included six fungicide treatment schemes and a control variant. The aim of research was to evaluate the formation of winter wheat yield, yield components and quality indicators depending on variety and fungicide application. Wheat yield, 1000 grain weight, falling number and green leaf area were significantly affected by fungicide application. Almost all measured indicators were affected by the used variety. The winter wheat yield level was high – on average 11.73 t ha^{-1}. Variety 'Skagen' gave the highest yield when fungicides (including strobilurine fungicide) were applied at GS 31 and GS 49. Three leaf diseases were found in the trial, and the development of diseases was low.

Appendix 9

A C K N O W L E D G M E N T

The research was carried out to promote the State and EU support investments in agriculture within the framework of the project "Calculation of the maximum fertiliser rates for cultivated plants".

Soil chemical analyses were done using the financing from the research project No. 04.1058 of the Latvian Council of Science.

Thanks to Dr. Andris Ozols for his valuable recommendations for the economic substantiation of my Thesis.

I am also thankful to Anda Liniņa, Head of the LPTF Grain and Seed Study and Research Laboratory, for her help in acquiring the methodology of grain quality analyses.

Many thanks to Vija Ozoliņa, an engineer of the Mathematics Department, for her support in the statistical analysis of experimental data and the useful advices concerning mathematical statistics and computer application.

I am also grateful to my spouse Andris for his assistance in preparing the visual aids.

Appendix 10

LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF AGRICULTURE AND FOOD TECHNOLOGY

Review of a Bachelor/Master thesis
(*for an experimental work*)

Author:

Title:

Amount: basic section p., tables, figures, appendices.

1. **Formulation of topicality, objective and tasks.**

2. **Review of the literature** (logic, relevance to the theme, the quality and amount of the literature sources used, the percentage of research papers from scientific journals or proceedings out of the total number of sources cited).

3. **Methodology** (logic and completeness of the description; adherence to methodological requirements).

4. **Arrangement of the assignment** (the ability to generalize the results obtained; data statistical processing, analysis and interpretation; economic and ecological assessment of the results if envisaged in the assignment, etc.).

5. **Conclusions** (logic; relevance to the thesis' subject-matter; explanations provided to the thesis' tasks).

6. **Technical layout of a thesis** (compliance with the instructions for thesis' elaboration, including bibliographic references; the quality and layout of summaries, etc.).

7. **The language – style, preciseness, professional terminology.**

8. **Other comments** (student's publications, participation at conferences, etc.).

Appendix 10 (continued)

D E C I S I O N

1. **The work is approved** (or rejected) **for public defense.**

2. **Evaluation of the work with a grade, providing a substantiation** (for a Bachelor thesis).

   Recommendation to grant (not to grant) **a Master's degree** (for a Master thesis).

3. **Additional recommendations, suggestions** (promote the work for competitions, expositions, publishing, etc.).

Reviewer: (*name, surname, scientific degree, position*)

Date Signature

Appendix 10 (continued)

LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF AGRICULTURE AND FOOD TECHNOLOGY

Review of a Bachelor/Master thesis
(*for a literature review*)

Author:

Title:

Amount: basic section p., tables, figures, appendices.

1. **Introduction:** formulation of topicality, objective and tasks.

2. **Basic section:** Review of the literature (logic, relevance to the theme, the quality and amount of the literature sources used, the percentage of research papers from scientific journals or proceedings out of the total number of sources cited).

3. **Discussion:** whether the findings have been analyzed in the review, whether there is a discussion, the quality of the discussion.

4. **Conclusions** (logic; relevance to the thesis' subject-matter; explanations provided to the thesis' tasks).

5. **Technical layout of a thesis** (compliance with the instructions for thesis' elaboration, including bibliographic references; the quality and layout of summaries, etc.).

6. **The language – style, preciseness, professional terminology.**

7. **Other comments** (student's publications, participation at conferences, etc.).

Appendix 10 (end)

D E C I S I O N

4. **The work is approved** (or rejected) **for public defense.**

5. **Evaluation of the work with a grade, providing a substantiation** (for a Bachelor thesis).

   Recommendation to grant (not to grant) **a Master's degree** (for a Master thesis).

6. **Additional recommendations, suggestions** (promote the work for competitions, expositions, publishing, etc.).

Reviewer: (*name, surname, scientific degree, position*)

Date Signature

Appendix 11

Examples of tables

Table 3.1.

Winter wheat grain yield, t ha^{-1}

Fertiliser rate*	Sowing rate, seeds per m^2	Years of trial			On average in three years
		2010	2011	2012	
$N_{60}P_{60}K_{60}$	450	4.37	5.38	6.29	5.35
	200	–	…	6.19	×
$N_{90}P_{90}K_{90}$	450	4.37	5.39	6.23	5.35
	200	3.74	5.76	6.51	5.34
$N_{120}P_{90}K_{90}$	450	4.49	5.58	6.57	5.55
	200	3.76	5.61	6.53	5.30
$\alpha_{0.05}$		0.203	0.165	0.194	0.108

* amount of N, P_2O_5 and K_2O, kg ha^{-1}

Table 3.2.

Use of fertilisers on the private farm "Īves" in 2020

Field No.	Area, ha	Fertiliser				Organic fertiliser		
		amount, kg ha^{-1}			application date	type	amount, t ha^{-1}	application date
		N	P_2O_5	K_2O				
1.	8.5	50	15	85	10.05.2020.	–	–	–
2.	12.0	45	18	90	25.04.2020.	compost	40	10.10.2019.
3.	5.8	90	50	65	01.05.2020.	manure	50	15.10.2019.
On average on a farm		57	24	83	×	×	29	×

Table 3.3.

Activities carried out in the trial and their costs in 2020

Activity	Date	Costs, euro	Notes
Field trial set-up	23.04.	15.00	Except the costs of markers
Soil sampling	25.04.	15.00	–
Fertiliser application	29.04.	45.50	Superphosphate and KCl
Fertiliser application	30.04.	55.05	Ammonium nitrate
Sowing of barley	02.05.	35.55	–

Table 3.3. (end)

Activity	Date	Costs, euro	Notes
Soil nitrogen quick-tests	25.05.	35.00	–
Plant nitrogen quick-tests	27.05.	55.00	–
Harvesting, yield recording	25.08.	75.80	Including yield sampling
Total costs		**311.90**	–
of which wages for contract workers		125.85	–
Costs per one trial treatment		31.19	–
Costs per one trial plot		7.80	–

Appendix 12

Examples of figures

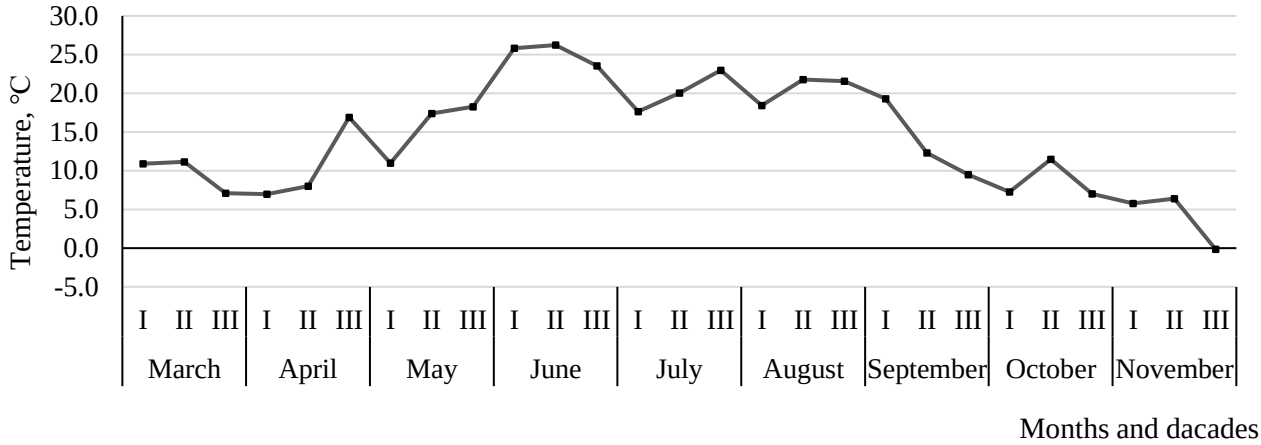

Fig. 3.1. Average decades' air temperature in 2019, °C (according to the data of hydrological station "Sigulda" of the Latvian Environment, Geology and Meteorology Centre).

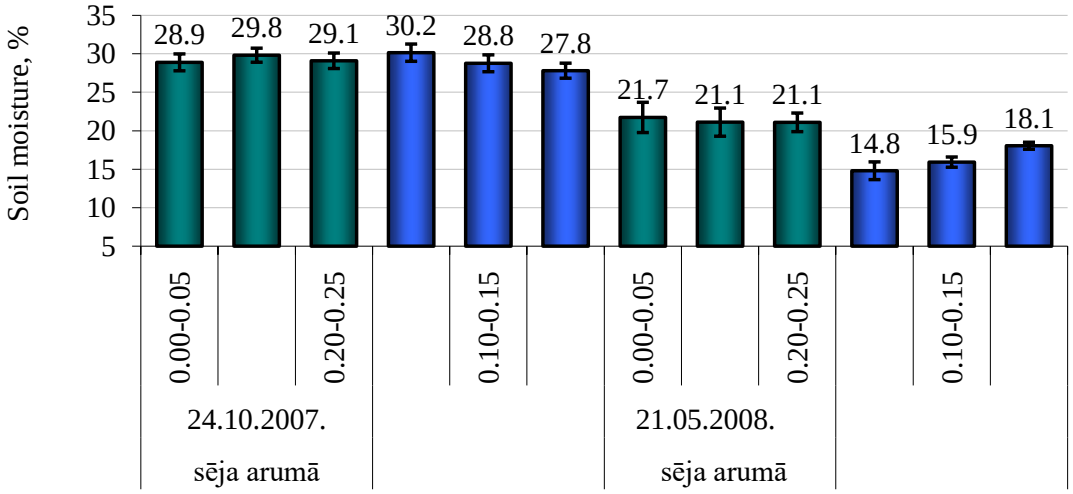

Fig. 3.2. Soil moisture depending on the technologies of soil tillage and sowing.

Appendix 12 (continued)

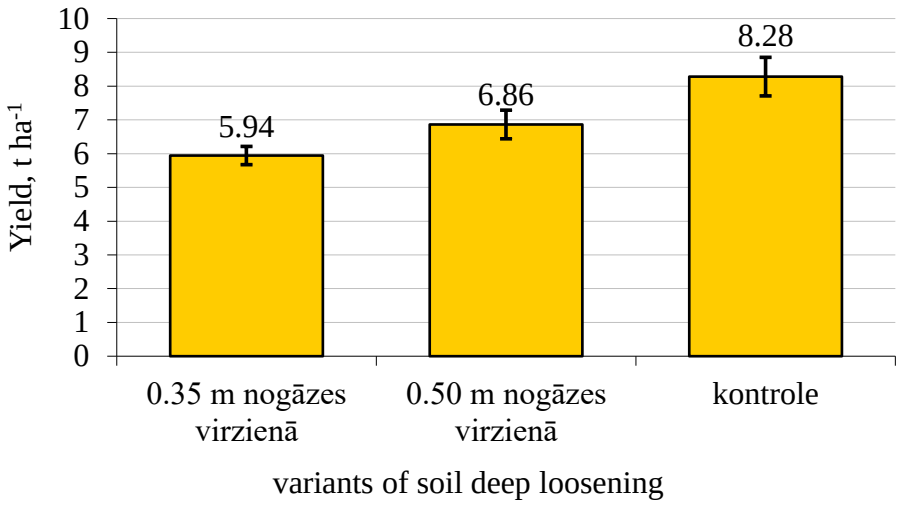

Fig. 3.3. Winter wheat yield depending on soil deep loosening.

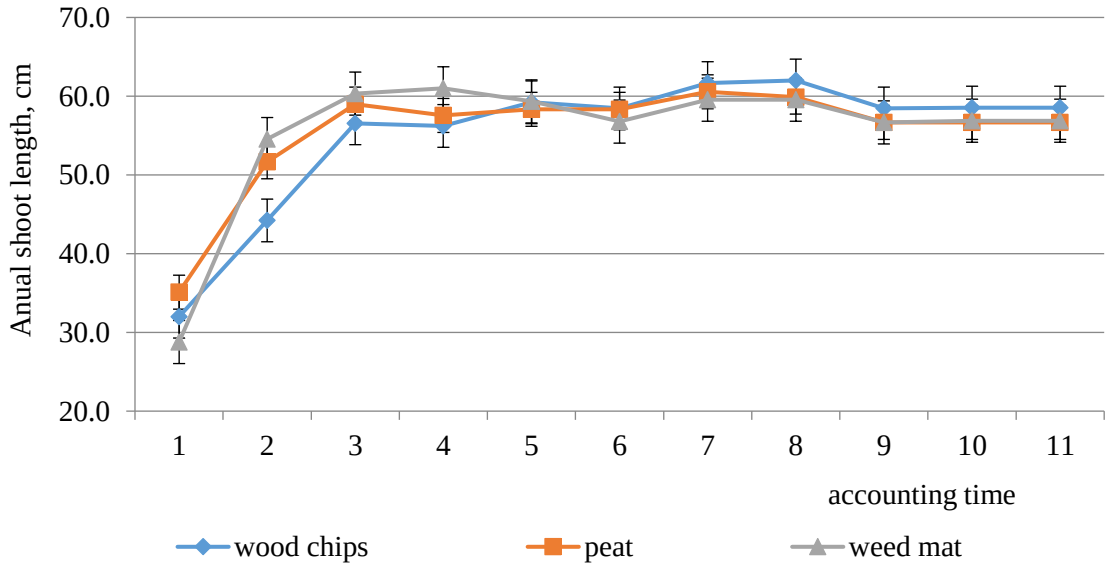

Fig. 3.4. Annual shoots growth dynamics of the highbush blueberry variety 'Bluecrop' in different mulches.

Appendix 12 (end)

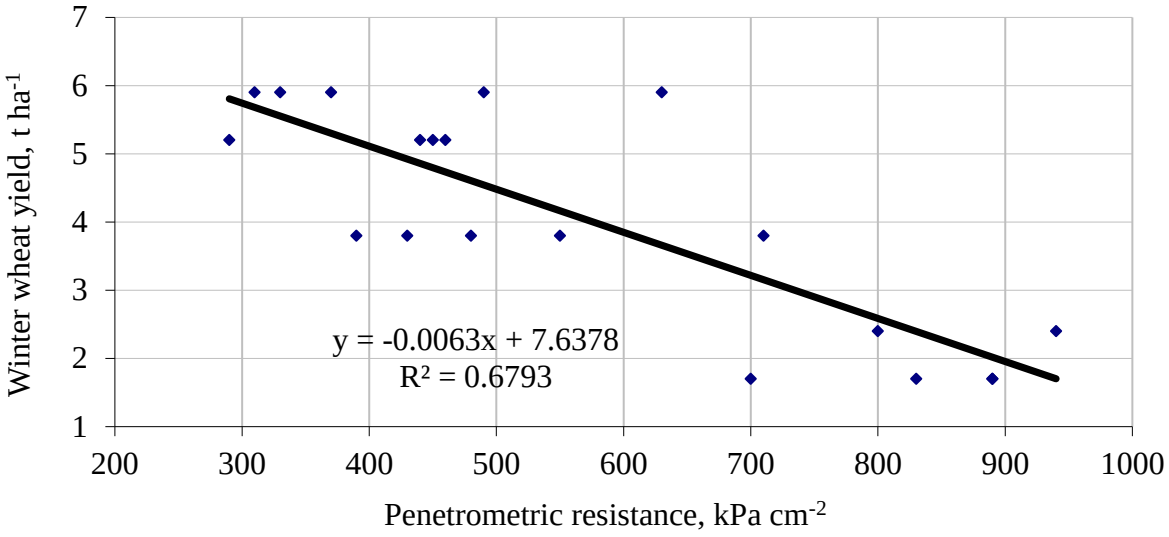

Fig. 3.6. Soil penetration resistance and winter wheat grain yield.

Fig. 3.7. Experimental plots of ornamental red fescue ‘Simone’ on May 30, 2020.

Appendix 13

SI system base and derived units

Parameter	Name of a unit		Non-SI units allowed to use
SI principal units			
Length	meter	m	–
Mass	kilogram	kg	metric ton, t
Time	second	s	minute, min; hour, h; day, d; year, yr
Electric current	ampere	A	
Thermodynamic temperature	kelvin	K	degree Celsius, °C
Amount of substance	mole	mol	–
Luminous intensity	candela	cd	–
Si derived units			
Pressure	pascal	Pa	–
Energy, work, quantity of heat	joule	J	–
Power, radiant flux	watt	W	–
Illuminance	lux	lx	–
Radioctivity (absorbed dose)	gray	Gy	–
Area	square meter	m^2	hectare, ha
Volume	cubic meter	m^3	litre, L
Velocity	meter per secend	$m\ s^{-1}$	–
Density	kilogram per cubic meter	$kg\ m^{-3}$	–
Specific valume	cubic meter per kilogram	$m^3\ kg^{-1}$	–

The basic units are possible to increase (multiply) or decrease (divide) by certain degrees using decimal factors and respective suffixes. The short symbols of units can be used only in the headings of table columns, in formulas, as well as after numerical values in the text. The full name of a unit should be placed together with its numerical value in the same row, with a space between the last digit of a value and the symbol of a unit; exceptions are the percentage and centigrade designations, where the symbol is placed directly after the numerical value, for example, 1 L, 4 m^3, 15°C, 32%, 5 $m\ s^{-1}$, etc. A full stop is not put after measurement symbols as they are not abbreviations, except when a sentence ends with a symbol.

Multipliers and prefixes used for the formation of decimal units

Multiplier	Name and designation of a prefix		Multiplier	Name and designation of a prefix	
$1\ 000\ 000\ 000 = 10^9$	giga	G	$0.01 = 10^{-2}$	centi	C
$1\ 000\ 000 = 10^6$	mega	M	$0.001 = 10^{-3}$	milli	M
$1\ 000 = 10^3$	kilo	k	$0.000\ 001 = 10^{-6}$	micro	μ
$100 = 10^2$	hecto	h	$0.000\ 000\ 001 = 10^{-9}$	nano	N
$0.1 = 10^{-1}$	deci	d	×	×	×

Appendix 14

Examples of the bibliographic references of information resources

Examples are arranged according to the groups of sources, whereas the list of References in a student's individual work should be arranged in alphabetical order (see Subchapter 2.7. and Appendix 15).

1. Monographic publications

1.1. Books with a single author

Heistinger A. (2010). *Handbuch Samengärtnerei: Sorten erhalten, Vielfalt vermehren, Gemüse genießen*. 2. aktualisierte Aufl. Stuttgart (Hohenheim): Ulmer. 424 S.

Segliņš V. (2007). *Zemes dzīļu resursi*. Rīga: Raka. 380 lpp.

1.2. Books with two and three authors

Bankina B., Gaile Z. (2014). *Ziemāju labības un to slimības*. Jelgava: LLU. 104 lpp.

Kolb W., Schwarz T. (2006). *Mit Pflanzen gestalten: Pflanzungen planen, ausführen und pflegen.* Stuttgart, Hohenheim: Ulmer. 172 S.

Kuršs V., Stinkule A. (1997). *Latvijas derīgie izrakteņi.* Rīga: LU. 200 lpp.

Lagreid M., Bockman O.C., Kaarstad O. (1999). *Agriculture, Fertilizers and the Environment.* [S.l.]: CABI Publishing. 294 p.

Newman R.K., Newman C.W. (2008). *Barley for food and health: science, technology, and products*. Hoboken, New Jersey: A John Wiley & Sons. 245 p.

1.3. Books with a group of authors

Agricultural Soils in Northern Europe: A Geochemical Atlas (2003). [compact disc]. C. Reimann, U. Siewers, T. Tarvainen et al. Hannover. 280 p. CD.

An Introduction to Environmental Chemistry (1996). J.E. Andrews, P. Brimblecombe, T.D. Jickells, P.S. Liss. [S.l]: Blackwell Science. 209 p.

Latvijas augšņu noteicējs (2009). A. Kārkliņa red. A. Kārkliņš, I. Gemste, H. Mežals, O. Nikodemus u.c. Jelgava: LLU. 240 lpp.

Modern corn and Soybean production (2000). R.G. Hoeft, E.D. Nafziger, R.R. Johnson, S.R. Aldrich. Illinois: Champaign. 353 p.

Wheat science and trade (2009). Ed. by B.F. Carver. Iowa: Wiley–Blackwell. 569 p.

1.4. Books with a corporate or a group author

Guidelines for Soil Description (2006). Food and Agriculture Organization of the United Nations. 4th ed. Rome: FAO. 97 p.

Soil Atlas of Europe (2005). European Soil Bureau Network, European Commission. 128 p.

1.5. Books with no author

Munsell Soil Color Charts (2000). GretagMacbeth. 28 p.

Appendix 14 (continued)

1.6. Encyclopedia

Encyclopedia of Soils in the Environment (2005). Ed.-in-chief D. Hillel. Vol. 1. Amsterdam [etc.]: Elsevier Academic Press. 548 p.

Latvija. Zeme, daba, tauta, valsts (2018). O. Nikodemus, M. Kļaviņš, Z. Krišjāne, V. Zelčs (zin. red.). Otrais laidiens. Rīga: Latvijas Universitātes Akadēmiskais apgāds. 752 lpp.

Latvijas daba (1995). 3. daļa. Rīga: Latvijas enciklopēdija. 254 lpp.

Latvijas daba (1997). 4. daļa. Rīga: Preses nams. 254 lpp.

Meža enciklopēdija (2003). J. Broka red. 1. sējums. Rīga: Zelta grauds. 368 lpp.

2. Part of a monographic publication

Bušmanis P., Jansons V., Kārkliņš A., Kiršteina D. (2005). Lauksaimniecības un vides riska modelēšana ar ĢIS metodēm. ***No:*** *Riski lauksaimniecībā un privātajā mežsaimniecībā*. P. Rivžas red. Jelgava: LLU, TU, 363.–384. lpp.

Krūmiņš K. (1936). Latvijas augsnes. ***No:*** *Latvijas zeme, daba, tauta.* Rīga, 361.–446. lpp.

O'Halloran I.P., Cade-Menum B.J. (2008). Total and organic phosphorus. ***In:*** *Soil Sampling and Methods of Analysis*. Ed. by M.R. Carter, E.G. Gregorich. 2nd ed. Canadian Society of Soil Science, p. 265–291.

3. Serial publications

Bankina B., Gaile Z., Balodis O., Bimšteine G., Katamadze M., Kreita D., Paura L., Priekule I. (2014). Harmful winter wheat diseases and possibilities for their integrated control in Latvia. *Acta Agriculturae Scandinavica, Section B – Soil and Plant Science,* Vol. 64, Issue 7, p. 615–622.

Dourmad J.Y., Seve B., Latimier P., Boisen S., Fernandez J., Peet-Schwering C., Jongbloed A.W. (1999). Nitrogen consumption, utilization and losses in pig production in France, The Netherlands and Denmark. *Livestock Production Science,* Vol. 58, No. 3, p. 261–264.

Karklins A. (2005). Fertilizer use strategy for sustainability – Latvian approach. *Почвоведение и агрохимия*. Институт Почвоведения и агрохимии Национальной Академии Наук Беларуси, No. 1 (34), с. 22–27.

Karklins A., Ruza A. (2015). Nitrogen apparent recovery can be used as the indicator of soil nitrogen supply. *Zemdirbyste–Agriculture,* Vol. 102, Issue 2, p. 133–140.

Līpenīte I., Kārkliņš A. (2007). Pētījumi par NPK bilanci zemnieku saimniecībās. VI. Jelgavas raj. Vilces pagasta "Terēni". *Latvijas Lauksaimniecības universitātes Raksti,* Nr. 18 (313), 9.–16. lpp.

Šematoviča I., Martinsons T., Līdaks M., Kanska I. (2019). Linear conformation traits in Latvian Blue cows in relation to possession to gene pool and discarding. *Rural Sustainability Research,* 41(336), p. 2–7.

Appendix 14 (continued)

4. Materials of conferences

4.1. Materials of LLU conferences

Bankina B., Bimšteine G., Katamadze A, Kreita D. (2016). Lauka pupu slimības un to ierobežošanas efektivitāte. ***No****: Līdzsvarota lauksaimniecība*, Zinātniski praktiskās konferences raksti (2016. g. 25.–26. febr.). Jelgava: LLU, 12.–17. lpp.

Litke L., Ruža A. (2015). Slāpekļa mēslojuma ietekme uz ziemas kviešu ražu un kvalitāti. ***No****: Ražas svētki "Vecauce – 2015": Lauksaimniecības zinātne reorganizācijas laikā*, Zinātniskā semināra rakstu krājums (2015. g. 5. nov.). Jelgava: LLU, 8.–13. lpp.

Daugaviņa L., Brauna-Morževska E., Plūduma-Pauniņa I., Kaņeps J., Bankina B. (2020). Development of chocolate spot disease in faba bean over a five-year period in Semigallia region. ***In:*** *Students on Their Way to Science,* 15th International Scientific Conference (undergraduate, graduate, post-graduate students), Collection of Abstracts (24 April, 2020). Jelgava: LLU, p. 10.

Zeipiņa S., Alsiņa I., Lepse L. (2015). Influence of agroecological factors on artichoke yield and quality: review. ***In:*** *Research for Rural Development 2015,* Annual 21st International Scientific Conference Proceedings (13–15 May, 2015), Vol. 1. Jelgava: LLU, p. 77–81.

4.2. Materials of other conferences

Kõlli R., Karklins A., Marcinkonis S., Astover A., Toomsoo A. (2008). Soil phosphorus status in Baltic countries and its sustainable management. ***In:*** *Book of abstracts: NJF Seminar 401 "Phosphorus management in Nordic-Baltic agriculture – reconciling productivity and environmental protection"*, Uppsala, Sweden, September 22–23, 2008. Ed. by G.H. Rubaek. NJF Report, Vol. 4, No. 4, p. 92–96.

Baltic agriculture – reconciling productivity and environmental protection, Book of abstracts, NJF Seminar 401 (22–23 September, 2008), ed. by G.H. Rubæk. Uppsala, Sweden, p. 92–96.

Sulek A., Wyzinska M., Cacak-Pietrzak G. (2019). Impact of tillage on yield and quality traits of grains of spring wheat cultivars. ***In:*** *Engineering for Rural Development 2019,* Proceedings of 18th International Scientific Conference (22–24 May, 2019). Jelgava: LLU, p. 600–606.

Karklins A., Lipenite I. (2006). NPK balance calculation as a tool for sustainability assessment. ***В кн.:*** *Современные проблемы повышения плодородия почв и защиты их от деградации:* материалы международной научно – практической конференции, посвященной 75–летию института почвоведения и агрохимии НАН Беларуси и III съезда почвоведов (27–29 июня 2006 г.). Минск, Беларусь, с. 109–110.

Appendix 14 (continued)

5. Electronic resources

5.1. Online resources

Augu šķirnes saimniecisko īpašību novērtēšanas noteikumi: MK Noteikumi Nr. 518. Stājas spēkā 02.08.2012., ar grozījumiem. [Tiešsaiste] [skatīts 2020. g. 15. jūn.]. Pieejams: https://likumi.lv/ta/id/250577-augu-skirnes-saimniecisko-ipasibu-novertesanas-noteikumi.

Grozījumi MK 2001. gada 18. decembra noteikumos Nr. 531 "Noteikumi par ūdens un augsnes aizsardzību no lauksaimnieciskas darbības izraisītā piesārņojuma ar nitrātiem" (MK 27.12.2005. not. Nr. 1015; MK 16.10.2007. not. Nr. 708). (2007) [Tiešsaiste] [skatīts 2020. g. 22. nov.]. Pieejams: http://www.likumi.lv/doc.php?id=124799.

HELCOM Recommendation 28E/4. Amendments to Annex III "Criteria and measures concerning the prevention of pollution from land-based sources" of the 1992 Helsinki Convention. Adopted on 15 November 2007 [Online] [viewed January 20, 2021]. Available: http://www.helcom.fi/Recommendations/en_GB/rec28E_4/

Lauksaimniecības un lauku attīstības likums: LR likums. Stājas spēkā 24.04.2004., ar grozījumiem. [Tiešsaiste] [skatīts 2020. g. 24. aug.]. Pieejams: http://www.likumi.lv/doc.php?id=87480.

Minimālās augsnes apstrādes ietekme uz augsnes auglības saglabāšanu, kaitīgo organismu attīstību un izplatību, ražu un tās kvalitāti bezmaiņas sējumos (2017). Atskaite par ZM subsīdiju projektu Nr. S310. Latvijas Lauksaimniecības universitāte. Projekta vad. A. Ruža [Tiešsaiste] [skatīts 2020. g. 15. jūn.]. Pieejams: https://www.llu.lv/sites/default/files/files/projects/S310_atskaite.pdf.

5.2. Electronic databases

The European Soil DataBase (2004): version V2.0. European Commission, European Soil Bureau Network. CD

6. Bachelor, Master and Doctoral theses

6.1. Bachelor, Master, and Doctoral theses (dissertations)

Balodis O. (2017). *Agroekoloģisko faktoru ietekme uz ziemas rapša (Brassica napus* L.*) augšanu un attīstību:* Promocijas darbs Dr. agr. zinātniskā grāda iegūšanai. Latvijas Lauksaimniecības universitāte. Jelgava, LLU. 111 lpp.

Kaņeps J. (2020). *Botrytis ģints patogēni kā nozīmīgi lauka pupu (Vicia faba L.) slimību ierosinātāji*: zinātniskais darbs maģistra grāda ieguvei. Latvijas Lauksaimniecības universitāte. Jelgava, LLU. 61 lpp.

Ottabbong E. (1983). *Lime requirements, influences and residual effects of lime on two acid carex peats and barley (Hordeum vulgare* L.*) in incubation and pot experiments*: doctoral dissertation. Uppsala, Swedish University of Agricultural Sciences. 43 p.

6.2. Summaries of Doctoral theses and dissertations

Gailis J. (2018). *Skrejvaboles (Coleoptera: Carabidae) kā integrētās augu aizsardzības indikatori kviešu sējumos:* promocijas darba kopsavilkums Dr. agr. zinātniskā grāda iegūšanai. Jelgava: LLU. 47 lpp.

Appendix 14 (continued)

Kārkliņš A. (1997). *Augsnes resursi un mēslošanas līdzekļu lietošanas pētījumi ilgtspējīgas lauksaimniecības apstākļos*: zinātniskā darba kopsavilkums Dr. habil. agr. zinātniskā grāda ieguvei. Jelgava: LLU. 113 lpp.

Pupaliene R. (2004). *The residual effect of different agricultural systems on spring barley agrocenosis*: summary of doctoral dissertation: Biomedical sciences, agronomy: (02.04.04.). Kaunas: LUA. 21 p.

7. Normative-technical documents

7.1. Standards

LVS EN ISO 16472: 2006. *Dzīvnieku barība. Ar amilāzi apstrādātu neitrālos mazgāšanas līdzekļos nešķīstošu šķiedru satura (aNDF) noteikšana* (2006). LVS: Standartizācijas nodaļa, Latvijas standarts.

LVS EN ISO 5983-1:2005/AC:2009. *Dzīvnieku barība. Slāpekļa satura noteikšana un kopproteīna satura aprēķins. 1. daļa: Kjeldāla metode (ISO 5983-1:2005/Cor 1:2008)* (2009). LVS: Standartizācijas nodaļa, Latvijas standarts.

LVS ISO 6060:1989. *Ūdens kvalitāte: Ķīmiskā skābekļa patēriņa noteikšana* (1998). Rīga: Latvijas Nacionālais standartizācijas un metroloģijas centrs. 10 lpp.

7.2. Patent documents

LR Patentu valde. *Augu augšanas stimulēšanas paņēmiens.* I. Alsiņa, L. Dubova, U. Kauliņš, K. Kveksis, L. Zariņa (izgudrotāji). Int. CL.: CO5F11/00. Iesniegšanas datējums 2007.12.28. Patenti un preču zīmes. LV13690B. 2008.06.20

8. Unpublished material [10]

8.1. Projects and project reports

Augu barības elementu aprites pētījumi un mēslošanas līdzekļu optimizācija atbilstoši Labas Lauksaimniecības Prakses principiem (2004). Pārskats par LZP zinātnisko pētniecības projektu 01.07.65. Latvijas Lauksaimniecības universitāte. Tēmas vad. A. Kārkliņš. Jelgava: LLU. 131 lpp.

Baritz R., Eberhardt E. (2008). *Database Design and Selection*. ENVASSO Project (Contract 022713) coordinated by Cranfield University, UK, for Scientific Support to Policy. European Commission 6th Framework Research Programme. 138 p.

8.2. Technical reports, annuals, handbooks

Crop Identification and BBCH Staging Manual: SMAP-12 Field Campaign (2011). Earth Observation Research Branch Team, Agriculture and Agri-Food Canada. 49 p.

Farm Chemicals Handbook 2008 (s.a.). Section B: Fertilizer, p. B1 – B72.

JS Baltija: lietotāja rokasgrāmata (s.a.). Karšu izdevniecība Jāņa sēta. 47 lpp.

[10] Unpublished materials or materials with limited accessibility; references are made in footnotes.

Appendix 14 (end)

Soil Geographical Database for Eurassia & the Mediterranean (2002): instruction guide for elaboration at scale 1:1,000,000 version 4.0. J.J. Lambert, J. Daroussin, M. Eimberck et al. [S.l.], European Commission Joint Research Centre, INRA. 58 p.

8.3. Catalogues of industrial products

Agronomics Catalogue: Instrumentation for monitoring the agricultural environment (2008). ELE International. 258 p.

Parts and accessories for sprayers, spreaders and application systems (2007): Catalog 2008. Ag-Chem Equipment Co., Inc. 150 p.

8.4. Catalogues of companies

Amazone: Produkti. Amazonen-Werke H. Dreyer GmbH & Co. KG firmas katalogs. 37 lpp.

Rapid F: Väderstad–Verken AB, Sweden. 5 p.

Appendix 15

R E F E R E N C E S

1. Bankina B., Bimšteine G., Katamadze A., Kreita D. (2016). Lauka pupu slimības un to ierobežošanas efektivitāte. ***No****: Līdzsvarota lauksaimniecība*, Zinātniski praktiskās konferences raksti (2016. g. 25.–26. febr.). Jelgava: LLU, 12.–17. lpp.
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Appendix 16

Comparison of measurement units

Length

Basic unit – meter, m
m = 100 cm = 1000 mm
Kilometer, km = 1000 m

Area

Basic unit – square meter, m^2
m^2 = 10 000 cm^2 = 1 000 000 mm^2
ha = 10 000 m^2
km^2 = 100 ha = 1 000 000 m^2

Volume

Basic unit – cubic meter, m^3
m^3 = 1000 dm^3 = 1000 L = 1 000 000 mL
litre, L = dm^3 = 1000 mL

Mass

Basic unit – gram, g
g = 1000 mg = 0.001 kg
kg = 1000 g = 0.001 t
tonne (metric ton), t = 1000 kg = megagram, Mg

Yield, norm or rate of use

Basic unit – gram per square meter, g m^{-2}
g m^{-2} = 0.001 kg m^{-2} = 10 kg ha^{-1}
kg m^{-2} = 1000 g m^{-2} = 10 t ha^{-1}
kg ha^{-1} = 0.1 g m^{-2} = 0.001 t ha^{-1}
t ha^{-1} = 1000 kg ha^{-1} = 100 g m^{-2}

Mass of volume, volume of mass

Basic unit – gram per cubic meter, g m^{-3}
g m^{-3} = 0.001 kg m^{-3} = 0.001 g L^{-1} = 0.001 g dm^{-3} = 0.000001 g cm^{-3}
g cm^{-3} = t m^{-3} = 1000 kg m^{-3}

Concentration (mass per mass units)

g kg^{-1} = 1000 mg kg^{-1} = 100 mg 100 g^{-1} = 0.1%
% = g 100 g^{-1} = kg 100 kg^{-1} = 10 g kg^{-1}
mg kg^{-1} = 0.001 g kg^{-1} = 0.0001 g 100 g^{-1} = 0.0001%

Concentration (volume per volume units)

mL L^{-1} = L m^{-3} = 0.001 mL mL^{-1}

Appendix 16 (end)

Concentration (mass per volume units)

$g\ L^{-1} = g\ dm^{-3} = kg\ m^{-3} = 1000\ mg\ L^{-1}$

$g\ m^{-3} = mg\ L^{-1}$

Conversion of measurement units

$mg\ 100\ g^{-1} \times 0.001 = \%$

$mg\ kg^{-1} \times 0.0001 = \%$

$\% \times 1000 = mg\ 100\ g^{-1}$

$\% \times 10000 = mg\ kg^{-1}$

$mg\ 100\ g^{-1} \times 10 = mg\ kg^{-1}$

$mg\ kg^{-1} \times 0.1 = mg\ 100\ g^{-1}$

ppm (*part per million*) $= mg\ kg^{-1}$

To convert mass units into concentration units or vice versa, the bulk density of substance is taken into account. The following equations can be used:

$$m = V \times d \qquad \text{or} \qquad V = \frac{m}{d},$$

where m – mass,

V – volume,

d – bulk density of media (soil, substrate, solution, etc.).

Following these rules, the conversion is as follows:

$mg\ kg^{-1} = mg\ L^{-1} : d$

$mg\ 100\ g^{-1} = 0.1\ mg\ L^{-1} : d$

$mg\ L^{-1} = mg\ kg^{-1} \times d$

$mg\ L^{-1} = 10\ mg\ 100\ g^{-1} \times d$, etc.