Software Complex of Automation Examination of Seed

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Abstract— The article considers the features of the development of software complex of automation examination of seed in the State inspectorates of seed growing, quarantine and protection of plants.

Keywords— Examination of Seed, Software, Automation.

I. Introduction

No field can be sown, no packet of seeds can be realized on the market without the approbation of agricultural plants, without producing certificate of the quality of plant seeds and document on seeds plant. This defines the special importance of measures to determine quality of varietal and sowing properties of seeds of agricultural plants. State inspectorates of seed growing, quarantine and protection of plants provides quality control of the seeds of all crop grown in the territory of the Republic of Belarus, supervision over observance of requirements of technical regulations at all stages of the production and use of seeds. These actions perform in accordance with the Law of the Republic of Belarus 20-3 on May 2, 2013 about seed growing [3].

II. Organization of work in divisions of State inspection of seed growing, quarantine and protection of plants

Staff amount of the State Inspectorate is limited. Typically, in each district and regional inspectorates 3-4 people define varietal and sowing qualities of seeds. Most of the work is related to the conduct of expertise. Each examination is carried out according to a strictly regulated procedure [1]. The employee must always operate with a large number of reference data.

Table 1 presents some examples of requirements for varietal and sowing qualities of seeds of cereals. You can see that these requirements are divided not only for different names of agricultural plants, but also depend on the classification: varietal and sowing qualities of seeds, for parental components and for commercial purposes. There is also a separation of requirements for each stage of seed reproduction: original seeds, elite seeds, first reproduction, second-third reproductions and subsequent reproductions.

For each plant species, various impurities and different pests are considered. If we are talking about potatoes, the set of qualities is divided not only for elite and reproduction seeds, but the original seeds have different requirements: micro-plants in culture in vitro, the first tuber generation, the nursery of pre-breeding, super elite. The following qualities are evaluated:

1) Cleanliness of sort of landings,
2) Presence of plants affected by disease (by external signs), including:
    - light viral diseases (ordinary mosaic, mosaic twisting of leaves);
    - severe viral diseases (wrinkled mosaic, banded mosaic, twisting of leaves);

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- soil viruses;
- viroids;
- bacterial (black leg).

The presence of plants affected by a viral and bacterial infection in a latent form, including:

- viruses X, S, M, Y, L, A;
- bacterial infection (black leg).

3) Size of tubers (for varieties with an elongated shape, for varieties with a round-oval shape), mm.
4) Presence of tubers that do not fit in size.
5) Appearance of the plant.
6) Presence of plants, overgrown, other botanical varieties, pcs.
7) Presence of tubers with signs of "suffocation", frozen, with burns, ugly, cut, crushed, with peeled skin more than 1/3 of the tuber surface.
8) Presence of tubers with mechanical damages.

TABLE I
REQUIREMENTS FOR VARIETAL AND SOWING QUALITIES OF SEEDS OF CORNY AND CEREALS OF AGRICULTURAL PLANTS

Name of the agricultural plants	Quantity	Stages of Seed Reproduction
Oats (film forms)	Requirements for varietal qualities of seeds: High purity Infestation in sowing Requirements for seed quality of seeds: Purity of seed The content of seeds of other cultivated plants, except for winter rye seeds, pcs / kg The content of seeds of weed plants, total pcs / kg, including: difficult-to-separate (oats), poisonous (heliotrope pubescent, trihodessma gray-haired) Admixture of pouch bags and their parts Admixture of ergot sclerotia Germination Humidity Population of living pests and their larvae, except for mites pcs / kg Availability of mite pcs / kg	original seeds elite seeds first reproduction second-third reproductions subsequent reproductions
Varieties of Maize hybrids	Requirements for varietal qualities of seeds for parental components and for commercial purposes: Sort typical: Seed Hybridity Level: simple hybrids, double interlinear and three linear hybrids Contents of xenia grains: pcs. Requirements for quality of seeds Purity of seeds, not less than Seed content of other cultivated plants (does not apply to seeds intended for sowing, for fodder purposes), pcs / kg The content of weed seeds, pcs / kg including poisonous	original seeds elite seeds first reproduction second-third reproductions subsequent reproductions
Amaranth (Annual fodder and honey grasses)	Requirements for seed quality of seeds Purity of seeds, Seed content of other types of annual fodder and herbs (not for seeds intended for fodder sowing purposes), The content of weed seeds, including the most harmful (Cirsium setosum M. B.), pcs / kg Occupancy of live pests and their larvae, pcs / kg Germination, Humidity,	original and elite seeds, reproduction seeds
Origanum vulgare L. (seeds of vegetable agricultural plants)	Requirements for varietal qualities of seeds (seed,): High purity, The admixture of varieties and sharp hybrids among the total admixture in the third category, Requirements for seed quality of seeds: Purity of seeds, Seed content of other plants, including weed seeds Population of mite, live pests and their larvae, pcs / kg Germination, Humidity	original seeds elite seeds first reproduction second-third reproductions subsequent reproductions hybrid

9) Presence of tubers with pest damage.
10) The presence of tubers affected by disease, total, including:
- wet rot;
- black foot;
- dry rot (fusarium, anthracnose);
- stem nematode;
- ordinary and silvery scab (damage more than 1/3 of the tubers surface);
- Rhizoctonia (with damage from 1/10 to 1/4 inclusive the surface of the tubers).

11) Presence of land and impurities.
12) The presence of plants, tubers affected by a viral and bacterial infection in a latent form.

Thus, it can be seen what a huge amount of diverse data needs to be taken into account in order to conclude that a certain material is suitable.

Every action is accompanied by a large number of current registration and reporting documents [2].

Currently, there are not automation of all kinds of work in all divisions of State inspection of seed growing, quarantine and protection of plants. Results are recorded manually, stored on paper. As a result, the same data have to be put in different types of magazines. To generate reports, you must use a variety of source documents. It increases the time of the decision and reduces the efficiency of the inspection as a whole. As a consequence, a significant part of working time of experts have to spend on unproductive work, making of documents, reports, formularies, etc. Especially this situation is exacerbated in times of increasing congestion in State inspection, for example, in the period before planting.

Thus, it is necessary to increase the efficiency of the labor of specialists departments of test the State inspection of the Republic of Belarus on seed-growing, quarantine and protection of plants (of 6 regional and 129 district inspections), through the development and implementation of software system for automating the examination of seed.

III. The business process scheme formalized

Figure 1 shows a formalized model of seeds expertise in local and regional inspections realized in the developed software package.

The **Applicant** shall submit to the **Inspection** a statement which indicates information about themselves, about analyzable agricultural plant and the necessary test types (name of work), receives an invoice, formed on the basis of statements, pays bills and provides a document confirming the payment to the inspection, provides the material for analysis, will receive a document of the results after analysis.

The **Inspection** has ability to make changes to the base price list (limited access) according to the data received from bookkeeping department. **Inspection** makes out Order based on the statement of the **Applicant**, forms the invoice, receives the document on payment and material for the analysis, directs material to the analysis and issues documents on results of analysis. In case of lack of payment of the Order, **Inspection** deletes the Order from the list of orders. **Inspection** has access to the list of the available and executed orders.

Analyst selects samples, conducts tests, records data in electronic forms and forms all types of reporting documentation.

After the automation of the examination of seed in the State inspection on seed-growing, quarantine and protection of plants, the following approach to order-taking procedure implemented:

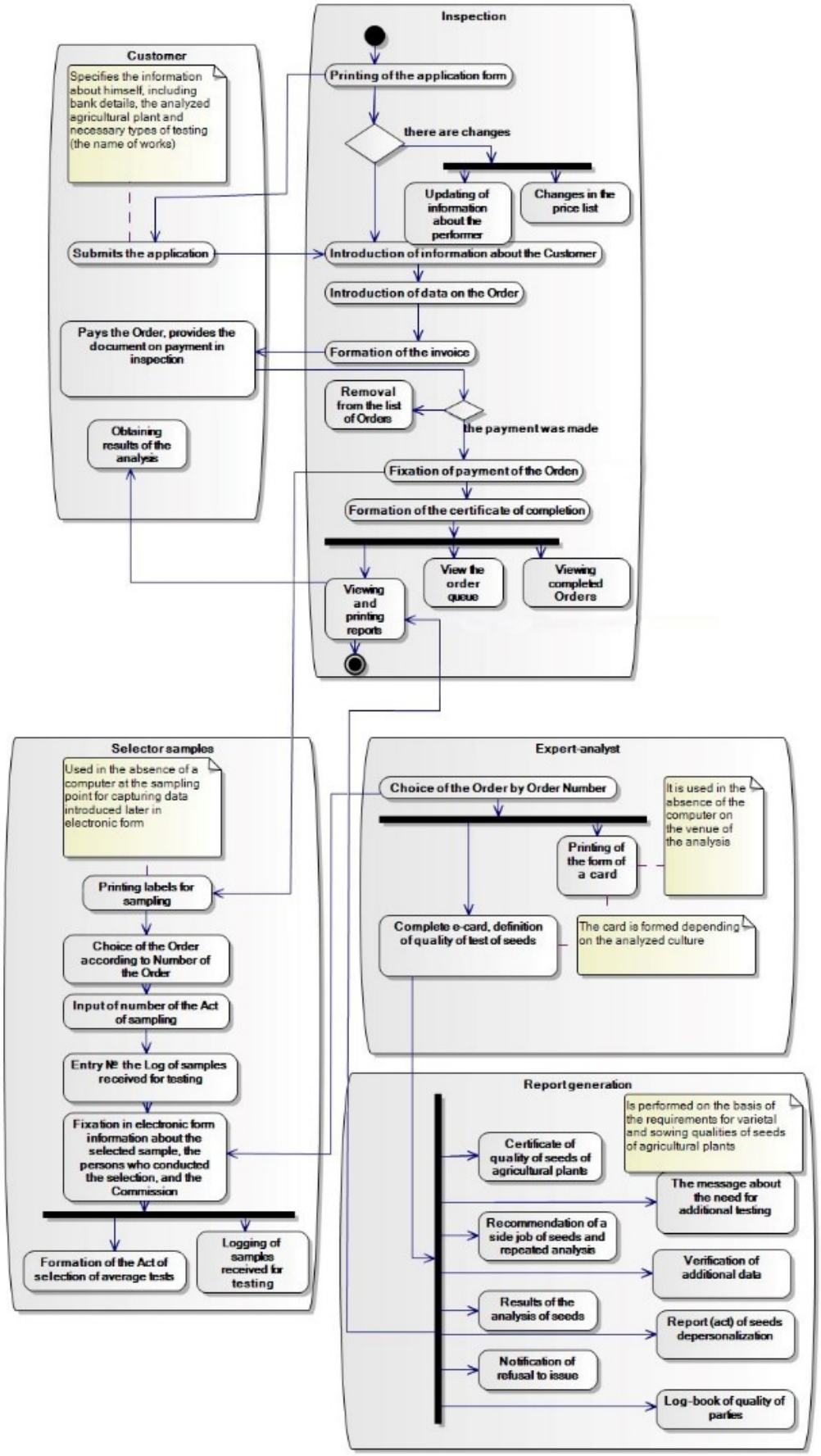

Fig. 1 Formalized model of seeds expertise in local and regional inspections

- Updating of information about the performer;
- Introduction of information about the Customer;
- Introduction of data on the Order;
- Changes in the price list;
- Formation of the invoice;
- Formation of the act of the performed works.

"Sampling for tests" is made of the material directed to the analysis, which provides information about the samples. Based on this information and the information received at the reception of the order Act of average sampling and sample Magazine, received at the trial are automatically generated. Upon transition, the dialog box with a reminder on need to save data will be brought out of the Order and Sampling tabs.

Use "Sample Analysis" option includes:

- The "Filling of a card" which is carried out in process of carrying out the analysis;
- "Formation of the report", which can be represented as the following: "Notice of refusal to issue", "Recommendation on seed refinement and re-analysis", "Certificate of Quality of agricultural plants seeds", "The results of the analysis of seeds";
- "The formation of conclusion", expandable up to "The message on need of additional tests" and "Verification of additional data".

By results of tests, the following options of use are allocated:

- "Formation of the report on a depersonalization of seeds" which is submitted by the Act of a depersonalization;
- "Formation of the Journal of Accounting for Party Quality", which can be extended to "Forming Reports of Arbitrary Form".

Figure 2 shows an example of the program interface for an order for sampling from lots of seeds of agricultural plants and for their analysis.

The system is capable of supporting a minimum of 15 concurrent users associated with a common database.

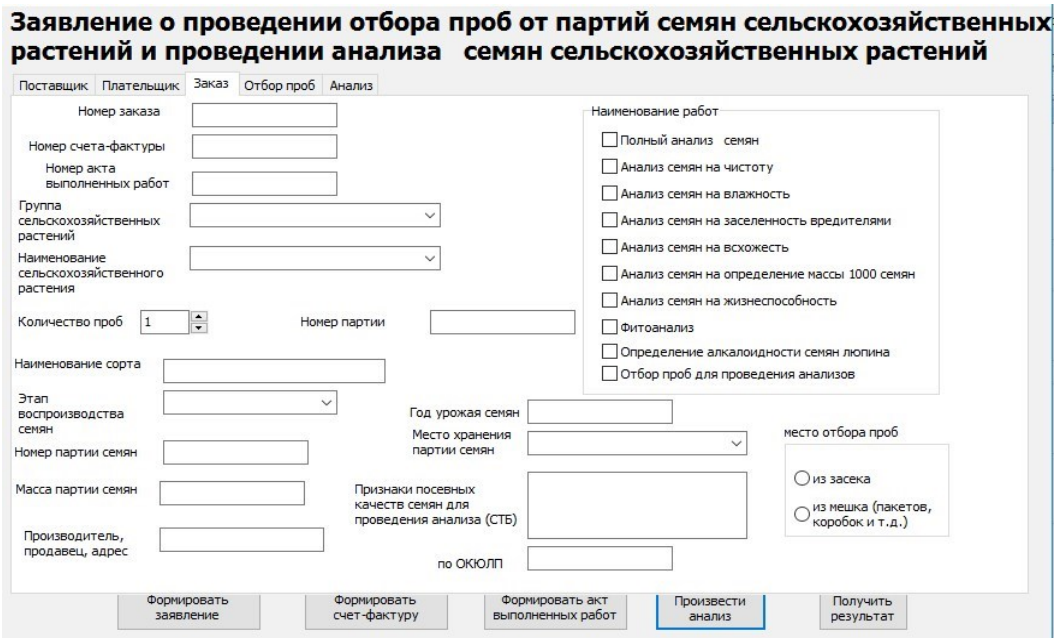

Fig. 2 The program interface of Automation Examination of Seed

The response time for typical tasks is no more than 5 seconds, for complex tasks no more than 20 seconds.

AWP is available on working days during working hours (usually from 8 to 18, unless otherwise specified by the order for the enterprise).

The time spent on maintenance of the system does not exceed 3% of the total operating time.

At the core of the system is an industrial database of relational access.

All access to information is carried out through the ODBC driver. C # programming language was used for development.

The developed software has the following advantages:

- Initial specialization in the subject area (as opposed to a widespread universal system "1C" type) increases usability;
- Modules for integration with existing systems, cross-sectorial document flow of Republic of Belarus;
- Flexibility and survivability (will allow increasing functionality of system);
- Openness (maintainability);
- Service automation (remote setting and maintenance of the system, back-up and optimization of stored data);
- Possibility of simultaneous use by multiple users;
- Usability (the possibility of rapid development of the user interface specialists with low levels of computer literacy, availability of contextual background information, enclosure of menu items no more than three levels, scaling for people with the weakened sight);
- Documents developed by system will meet the requirements of national standards, regulations and orders;
- Access to system will be provided by means of several preset automated workplaces (AWP), each of which has a certain set of the rights for viewing, creation, editing or other actions with documents;
- Scalability in terms of adding new workstations. Last two points are intended for simplification by reducing the number of options available at the same time and improve the reliability of differentiation by user authorization.

IV. Conclusions and future work

Using the software system of automation of examination of seeds in one State inspectorate for seed farming, a quarantine and protection of plants improved the efficiency and quality of work of this organization at the expense of an increase in labor productivity on 15 %.

As a result, time of examination is reduced, the quantity of tests increase; there is ability to quickly develop the necessary reports on any kind of activity of individual inspections, and in general for the Republic of Belarus. In a future more time will be allocated directly to conducting examinations, which will improve their quality. This promotes the formation of seed only from carefully selected specimens, which in turn increase the productivity of plants and, consequently, the economic security of our country.

In social terms, the effect of the use of this software will appear to facilitate routine work, often low paid. A possible reduction in the cost of these services for agricultural producers and importers will increase accessibility for the public inspection services.

The information system can be used in any State inspectorate for seed farming, a quarantine and protection of plants in the territory of Republic of Belarus as it is autonomous, and with use of the centralized access to the Republican database for storage of results of work of the State inspections.