

УДК 630*443.3

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BIOLOGICAL EFFICIENCY OF NEW SUBSTANCES FOR THE PRE-SOWING SEEDS TREATMENT IN SEEDLINGS PROTECTION FROM INFECTIOUS LODGING

Biological efficiency of new substances used for pre-sowing seeds treatment in coniferous plants seedlings protection from the agents of disease of the infectious lodging was established in the laboratory and field studies. It is shown that the new fungicides with a low phyto-toxicity level can effectively restrain the spread of infection. According to the tests results, the substances for pre-sowing seeds treatment were included into the State Register of Plant Protection.

Introduction. Arboretums represent an industrial object for planting stock cultivation – seedlings and saplings. In the initial cultivation stage the shoots are most strongly influence-prone to phytopathogen organisms, as external protective tissues protect plants not well enough from the whole complex of microorganisms possessing both strongly pronounced parasitic properties, and being weak (facultative) parasites. For this reason in quantitative expression the plants loss in arboretums can be very essential. In particular it concerns seeding sections where the plants affection by fungous pathogens can cause death of up to 100% of plants in the focus of such wildly-spread disease, as the infectious seedlings lodging.

One of effective methods of seedlings protection from infectious lodging is the pre-sowing seeds treatment by fungicide substances. Now in arboretums for coniferous species seeds treatment it is recommended to use three substances – Raksil; Maxim XL; Lamador [1]. However, taking into account the extensive species composition of terricolous fungi, capable to cause the infectious seedlings lodging, and also resistance of pathogens arising with time to narrow assortment of fungicides-protectants, the efficiency of protective measures (seeds treatment and soil soaking) decreases considerably in time. Firms-manufacturers of pesticides constantly expand the list of modern fungicides, effective against a wide pathogens spectrum and meeting the requirements of ecological safety. In this connection the screening of new seed protectants and study of their biological efficiency against fungous pathogens, causing an infectious lodging of shoots and seedlings was the purpose of our research.

Main part. In experiments the new highly effective seeds protectants widely tested in agriculture were used: Vial-TT (tiabendazol, 80 g/l + tebukonazol, 60 g/l); Vitaros (karboxine, 198 g/l + thiram, 198 g/l); Insure Perform (piraklostrobine, 40 g/l + tritikonazol, 80 g/l). Raksil substance (tebukonazol, 60 g/l), registered in the State Register

of Plant Protection was used as a standard for protection of pine and spruce against infectious lodging [2]. Non-treated seeds served as control. Seeds soaking was not done in experiments, only surface treatment was used according to methodical recommendations [1] in force.

The first part of researches was carried out in laboratory, substances phyto-toxicity in the given concentration, substances ability to disinfect seeds on surface (in Petri dishes), and also protection efficiency at soil sowing preliminary infected with *Fusarium oxysporum* fungus spores – one of the most widespread agents of disease of the infectious lodging were determined. The protectant phyto-toxicity was estimated according to the total number of normally germinating seeds in the test variants in relation to the reference one, and also according to the average height of the germinating plant on the 10th day of experiment and according to presence of necrosis tissues areas caused by the substance influence. Fungicides ability to superficial disinfection was estimated by quantity of moldy or tainted seeds. The substances consumption rate was taken taking into account recommendations of the fungicide firm-manufacturer and in experiments it was 0.5 l/ton of seeds for Vial-TT, Insure Perform and Raksil substances; for Vitaros it was 3 l/ton of seeds. Soil germination study experiment lasted 6 weeks, seeds were sowed in laboratory trays, the soil was periodically watered, the brairded plants were subdivided into healthy, affected and victims of the infectious lodging development.

The second part of experiment was carried out in the arboretum of Negorelsky experimental-training timber enterprise and in the quarantine arboretum of the SSI “Central botanical garden of Belarus NAS”. In the seeding section of arboretums some plots for test plants were assigned where seeds were sowed according to the traditional 4-line layout technology. Seeds of the Scotch pine and common spruce, preliminary treated by substances under test were used for sowing.

Experiments were laid by the method of blocks with randomized location of variants. 3-fold replication was used. Blocks were placed in series one after another. After shoots coming up the 2-fold soil soaking by solutions of substances under test was done with an interval of 15 days. After the first shoots coming up the affected and dead seedlings were counted every week. The experiment time was 2 months. After the end of the field researches the disease spread indexes and biological efficiency of the substances under test were counted up according to the standard procedures [3].

The main results of the laboratory experiment part are given in Table 1 and in Fig. 1–3.

In all test variants there were no symptoms of tissues necrosis at the experiment end. The laboratory germination ability of seeds and the size of the seedling being formed (including the length of a rootlet, a pedicle and needles being formed) decreased a little at fungicides treatment, that permitted us to draw a conclusion about low phytotoxicity of substances, and also to continue experiment and to test ability of fungicides to superficial disinfection of seeds.

Table 1

Comparative indexes of the germinated in Petri dishes seeds in the assessment of phyto-toxicity of the substances being tested

| Substance | Concentration, % | Germination | | Plant total length | |
|----------------------------|------------------|-------------|--------------|--------------------|--------------|
| | | % | % to control | mm | % to control |
| <i>Pinus sylvestris</i> L. | | | | | |
| Vial-TT | 0.1 | 83.8 | 91.3 | 15.3 | 78.9 |
| Vitaros | 0.1 | 84.5 | 92.0 | 14.9 | 76.8 |
| Insure Perform | 0.1 | 87.5 | 95.3 | 13.8 | 71.1 |
| Raksil | 0.1 | 86.7 | 94.4 | 15.0 | 77.3 |
| Control (water) | – | 91.8 | 100.0 | 19.4 | 100.0 |
| <i>Picea abies</i> L. | | | | | |
| Vial-TT | 0.1 | 74.2 | 87.3 | 11.7 | 82.4 |
| Vitaros | 0.1 | 70.9 | 83.4 | 13.2 | 93.0 |
| Insure Perform | 0.1 | 76.5 | 90.0 | 10.9 | 76.8 |
| Raksil | 0.1 | 70.1 | 82.5 | 8.3 | 58.6 |
| Control (water) | – | 85.0 | 100.0 | 14.2 | 100.0 |

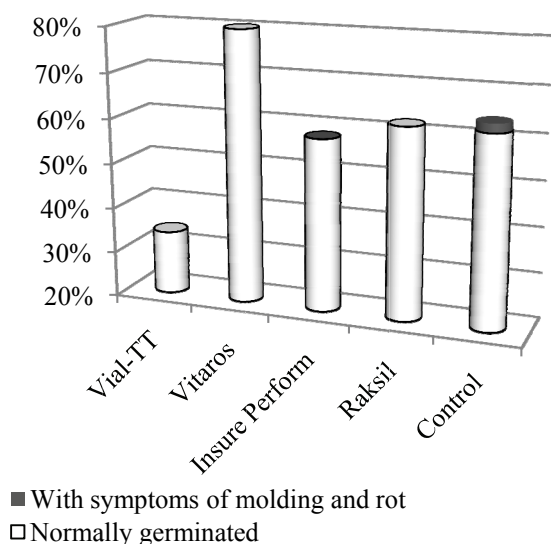


Fig. 1. Part of normally germinated seeds (%) in Petri dishes one week after the experiment beginning

A week of incubation of the treated seeds in Petri dishes in the moist chamber showed that all substances killed the surface infection well; only in control (non-treated seeds) there were symptoms of molding.

Fungicides in the tested concentration practically did not inhibit seeds germination, and in the case with

Vitaros substance the seeds germination speed even increased approximately on 10% in comparison with the reference variant. Certain negative influence on the germination speed was rendered at first by Vial-TT substance, however further it affected very little the total number of the germinated seeds.

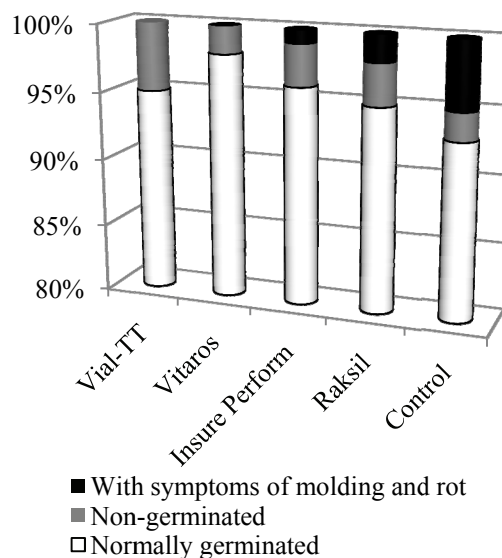


Fig. 2. Part of normally germinated seeds (%) in Petri dishes two weeks after the experiment beginning

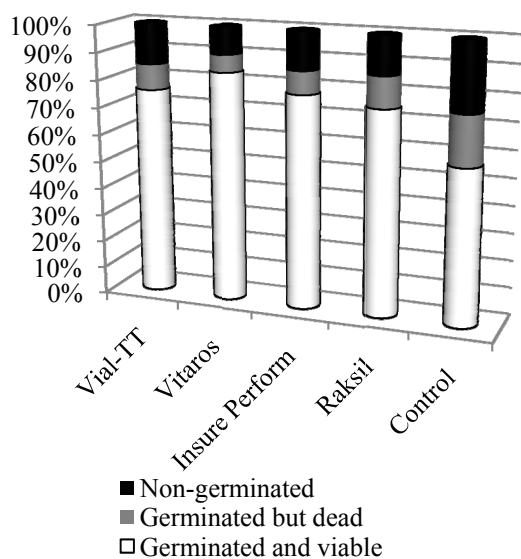


Fig. 3. Seedlings categories distribution at the end of the laboratory experiment on seeds sowing into the infected ground

At the experiment end the laboratory germination in control was 92%. More than 5% of seeds had symptoms of molding or rot. Indexes in variants with the protectant being tested appeared to

be better even than in the case with the standard (Raksil) – only up to 1% of seeds were affected.

Soil seeds sowing with a high infectious background of the agent of disease of the infectious lodging showed that the seed protectants used protect seeds effectively enough from the pathogen soil fungi, especially on preemergence stage. New substances action indexes were as good as the variant with the standard, and that gives the chance to recommend them for the field tests.

Results of the field researches are given in Tables 2–3.

Field experiments showed that all substances under test protected effectively the Scotch pine seedlings from infectious lodging at seeds sowing into the open ground.

Results are given taking into account the subsequent soil soaking by 0.1% fungicide solution in arising disease focuses with the substance consumption rate of 3–5 ml/m² of the soil. Insure Perform showed the greatest efficiency in the Scotch pine seedlings protection from infectious lodging. Prevalence of disease became almost 20 times lower in comparison with control, and the fungicide biological efficiency reached 90% in the experiments.

Table 2

Substances biological efficiency in shoots and seedlings protection of the Scotch pine from the infectious lodging

| Experiment variant | The substance consumption rate | Disease prevalence, % | The substance biological efficiency % |
|-----------------------------|---|-----------------------|---------------------------------------|
| Vial-TT | Seeds treatment – 0.5 ml/kg (0.5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 3.2 | 83.6 |
| Vitaros | Seeds treatment – 3 ml/kg (3.0 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 4.2 | 78.5 |
| Insure Perform | Seeds treatment – 0.5 ml/kg (0.5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 2.1 | 89.2 |
| Raksil (standard) | Seeds treatment – 0.5 ml/kg (0.5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 5.2 | 73.3 |
| Control (without treatment) | – | 19.5 | – |

Table 3

Substances biological efficiency in shoots and seedlings protection/ of the common spruce from the infectious lodging

| Experiment variant | The substance consumption rate | Disease prevalence, % | The substance biological efficiency % |
|-----------------------------|---|-----------------------|---------------------------------------|
| Vial-TT | Seeds treatment – 0,5 ml/kg (0,5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 6.1 | 73.6 |
| Vitaros | Seeds treatment – 3 ml/kg (3,0 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 6.2 | 73.2 |
| Insure Perform | Seeds treatment – 0,5 ml/kg (0,5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 3.5 | 84.8 |
| Raksil (standard) | Seeds treatment – 0,5 ml/kg (0,5 l/ton). Soil soaking in the focus – 3–5 ml/m ² | 6.4 | 72.3 |
| Control (without treatment) | – | 23.1 | – |

The substances under test also showed sufficiently high effectiveness in common spruce seedlings protection, reducing 4–7 times the disease prevalence level in the open ground. As in experiments with the Scotch pine, in spruce seedlings protection experiments the Insure Perform took first place. Fungicide biological efficiency was 84.8%.

On the whole, the fungicides under test had biological efficiency in pine and spruce protection against the infectious lodging at the level or above the level of the biological efficiency of the used now Raksil for the coniferous species seedlings protection.

Conclusion. Substances for the pre-sowing seeds treatment Vial-TT, Vitaros, Insure Perform, have high biological efficiency in pine and spruce seedlings protection from the agents of disease of the infectious lodging and in many cases are capable to provide a better plants protection in comparison with the widely used now protectants of coniferous species. The tested substances have sufficiently low phyto-toxicity and can reduce 4–20 times the disease prevalence in the open ground. Usage of the new substances will permit to

prevent the pathogens resistance to pesticides arising with time and will increase the protection efficiency in the arboretum sowing sections.

The fungicides tested by us were introduced into the “State register of plants protection (pesticides) and fertilizers, registered on the territory of the Republic of Belarus” as the substances for the pre-sowing seeds treatment of coniferous plants in protection against the infectious lodging.

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Received 21.01.2013