Consequences of using seed fungicides on daughter seeds of barley

E P Puchkova, V K Purlaur, V K Ivchenko and N A Mashkovskaya
Krasnoyarsk State Agrarian University, 90 Mira Avenue, 660049, Krasnoyarsk, Russia
E-mail: puchkova_el@mail.ru

Abstract. The consequences of applying prothioconazole-tebuconazole Lamador solution, mefenoxam-tebuconazole Serticor solution and prochloraz-imazalil-triticonazole Turion solution to the daughter seeds of Cedar breed barley were studied. The studied seed fungicides made a statistically significant (p<0.001) influence on the root rot intensiveness on the daughter seeds of barley. The most efficient variants were Turion and Serticor (disease incidence index was decreased by 0.9-9.0 pct, or by 1.0-2.4 times compared to the reference sample). Moreover, the studied fungicides made a statistically significant (p<0.01) influence on the sprout length and the overall root length of the barley. At all the experiment stages, the qualitative mycoflora composition was mainly represented by the plant pathogenic fungi Bipolaris sorokiniana and Alternaria sp. A negligible amount of the fungi Fusarium sp. and Penicillium sp. was detected.

1. Introduction
At the present moment, the most relevant task of today's agriculture is to increase the output of grain and other crop farming products. In this process, a great role is played by the protection of plants from harmful organisms that may induce a shortfall in crops production by 15-20% or more. In recent years, the greatest problem of agricultural crop farming has been the root rot causing material harvest losses. It is common in all the areas where grain crops are cultivated. As a rule, the root rot is caused by a series of facultative parasites, mainly representatives of Bipolaris sorokiniana, Alternaria sp., Fusarium, etc. The root rot harms the seed stock infesting the seeds, therefore decreasing their germinating capacity and germinating energy. Plant protection is an integral part of crops farming development. The chemical protection methods undergoing serious structural and technological changes are gaining more and more weight in this process. Justification of chemical protection as an economically costly method should be based on agroecological observations and phytosanitary forecasts. Phytosanitary observations with due regard to the terrain, predecessors, breeds and agricultural practices should be carried out at every protected field. The basis for a heavy and healthy harvest is the high-quality sowing seeds [1-9].

Therefore, the objective of the research was to study the consequences of applying Lamador, Serticor and Turion fungicides to the daughter seeds of barley.

2. Methods and results
The objects of research were the prothioconazole-tebuconazole Lamador solution produced by Bayer, mefenoxam and tebuconazole Serticor solution by Syngenta and prochloraz-imazalil-triticonazole
Turion solution by Agrochemical D.F. [10]. The test object of the research was the Cedar breed of barley.

The field studies were carried out at a small experimental plot at Minino experimental production farm of the State Scientific Institution 'Krasnoyarsk Scientific and Research Institute of Agriculture. The plot area in the small experimental plot facility was 10 square meters; the experiment was repeated four times.

The experiment pattern included the following variants:

- Control (untreated).
- Turion 0.35 l/t.
- Lamador 0.15 l/t.
- Serticor 0.9 l/t.

Nature zone: Krasnoyarsk forest steppe. Climate: moderately dry and continental. Selyaninov's hydrothermal index from May to September is 2.0. The topsoil is represented by a set of leached and common chernozem dominated by the common one of satisfactory fertility.

The laboratory tests were carried out in accordance with the applicable standards and methodological instructions. The phytopathological expertise of the daughter seeds was carried out with the roll culture method according to GOST 12044-93 [11]. The microorganisms were identified by their cultural and morphological features. For the microscopic studies, Micmed-6 optical microscope was used. The microphotography was done with DCM-130 digital camera. The mathematical processing of the research results was carried out with the variance analysis of the differences between the variants [12]. MS Office XP software was used.

The studies of the consequences of applying the selected fungicides on the daughter seeds of barley demonstrated that the presented set of fungicides makes a statistically significant (p<0.01) influence on the sprout length. Turion caused an increase of the sprout length by 2.2 cm. Lamador and Serticor caused a negligible decrease of the sprout length by 0.1 cm (figure 1, table 1).

![Figure 1](image-url)  
Figure 1. Influence of the seed fungicides on the barley sprout length.

| Variation source | SS    | df | MS       | F          | P value       | F critical |
|------------------|-------|----|----------|------------|---------------|------------|
| Between groups   | 15.09915 | 3  | 5.03305  | 6.035164   | **0.009537**  | 3.4903     |
| Inside groups    | 10.0074 | 12 | 0.833    | -          | -             | -          |
| Total            | 25.106 | 15 | -        | -          | -             | -          |

Table 1. Variance analysis of the barley sprout length differences between the variants.
An assessment of the effect made by the fungicides on the overall sprout root length showed that Lamador caused a verified increase of the overall root length by 1.7 cm. Serticor caused a verified increase of the overall root length by 6.0 cm (figure 2, table 2).

![Figure 2. Influence of the seed fungicides on the overall barley root length.](image)

**Table 2. Variance analysis of the overall barley root length differences between the variants.**

| Variation source | SS     | df | MS        | F         | P value   | F critical |
|------------------|--------|----|-----------|-----------|-----------|------------|
| Between groups   | 315.4747 | 3  | 105.1582  | 6.732004  | **0.006482** | 3.4903     |
| Inside groups    | 187.4477 | 12 | 15.62064  | -         | -         | -          |
| Total            | 502.9224 | 15 | -         | -         | -         | -          |

A measurement of the coleoptile length of the daughter seeds of barley showed that Turion caused an increase in the coleoptile length by 0.3 cm. Lamador caused a minor decrease in the coleoptile length by 0.1 cm. Serticor did not make any effect on the coleoptile length (figure 3, table 3).

![Figure 3. Influence of the seed fungicides on the barley sprout length.](image)

Nevertheless, no statistically significant difference in the effect on the barley coleoptile length was found between the experimental variants.

The studied seed fungicides made a statistically significant (p<0.001) influence on the root rot intensiveness on the daughter seeds of barley. Turion turned out to be the most effective one, causing a
decrease of the disease intensiveness by 9.0 pct or by 2.4 times compared to the reference (figure 4, table 3).

**Figure 4.** Disease intensiveness on the daughter seeds of barley.

**Table 3.** Variance analysis of the disease intensiveness on the daughter seeds of barley.

| Variation source | SS   | df | MS    | F     | P value     | F critical |
|------------------|------|----|-------|-------|-------------|------------|
| Between groups   | 240.9| 3  | 80.307| 38.451| 1.97E-06    | 3.490299605|
| Inside groups    | 25.0625 | 12 | 2.08854| -     | -           | -          |
| Total            | 265.9844 | 15 | -     | -     | -           | -          |

The fungi mycoflora of the daughter seeds of barley was represented by the microscopic fungi *Bipolaris sorokiniana*, *Alternaria* sp., *Fusarium* sp. and *Penicillium* sp. (figure 5).

**Figure 5.** Microscopic fungi on the daughter seeds of barley: *Bipolaris sorokiniana* (1), *Alternaria* sp. (2), *Fusarium* sp. (3), *Penicillium* sp. (4) (photo by Puchkova E P).
At that, the fungi species dominating in the reference sample were the representatives of Bipolaris sorokiniana (55% of the total number of the infested seeds) and Alternaria sp. (41% of the total number of the infested seeds). A minor share was represented by Fusarium sp. and Penicillium sp. (3% and 3% of the total number of the infested seeds, respectively). In the Turion variant, the Bipolaris sorokiniana fungi were represented (60% of the total number of the infested seeds) followed by Alternaria sp. (40% of the total number of the infested seeds). No representatives of Fusarium sp. or Penicillium sp. have been found. In the Lamador variant, the Bipolaris sorokiniana fungi were represented (56% of the total number of the infested seeds), then Alternaria sp. (41% of the total number of the infested seeds). An insignificant share was infested by Fusarium sp. (3%). In the Serticor variant, the Bipolaris sorokiniana fungi were represented (53% of the total number of the infested seeds), followed by Alternaria sp. (45% of the total number of the infested seeds). A minor share was infested by Fusarium sp. (2%). Penicillium sp. fungi were not detected (figure 6).

Figure 6. Mycomycetes composition on the daughter seeds of barley in different experimental variants.

3. Conclusion

Therefore, the studies of the consequences of applying the selected fungicides on the daughter seeds of barley demonstrated that the presented set of fungicides makes a statistically significant (p<0.01) influence on the sprout length and the overall root length. For instance, Turion caused an increase in the sprout length of barley by 2.2 cm, but a decrease of the overall root length by 6.2 cm. Serticor caused a minor decrease in the barley sprout length by 0.1 cm, with a simultaneously verified increase in the overall root length by 6.0 cm. Lamador caused an insignificant decrease in the sprout length by 0.1 cm but induced a verified increase in the root length by 1.7 cm. No statistically significant difference in the effect on the barley coleoptile length was found between the experimental variants.

The studied seed fungicides made a statistically significant (p<0.001) influence on the root rot intensiveness on the daughter seeds of barley. Turion and Serticor variants appeared to be the most effective ones, while the least effective was the variant of applying Lamador. At that, the disease incidence index was decreased by 0.9-9.0 pct, or by 1.0-2.4 times compared to the reference sample.
In all the experimental variants, the qualitative composition of the mycoflora was represented by plant pathogenic fungi *Bipolaris sorokiniana* (from 60% to 53% of the total number of the infested seeds) and *Alternaria* sp. (from 40% to 45% of the total number of the infested seeds). A minor presence of *Fusarium* sp. and *Penicillium* sp. fungi was found (from 0% to 3% of the total number of the infested seeds).

References

[1] Khaziev A Z, Zaitseva T V, Khakimullina F M 2015 The role of seed dressing in the fight against root rot 2015 *Zashchita i karantin rasteniy* 3 20-3

[2] Zheltova K V, Dolzhenko V I 2017 Root rot of winter wheat and their harmfulness *Vestnik OrelGAU* 1(64) 45-51

[3] Eliane T B 2017 Root Rot Diseases in Plants: A Review of Common Causal Agents and Management Strategies *Agricultural Research & Technology* 5(3) 1-8

[4] Toropova E Yu, Kirichenko A A 2012 *Phytosanitary environmental monitoring* (Novosibirsk: publishing house of NSAU) 41

[5] Puchkova E P, Gaas M V, Khizhnyak S V, Ivchenko V K and Polosina V A 2020 The occurrence of antagonists microorganisms to phytopathogenic fungi in consideration of various tillages *IOP Conf. Series: Earth and Environmental Science* vol 421 062037 (doi:10.1088/1755-1315/421/6/062037)

[6] Lankina E P, Bazhenova E N, Khizhnyak S V 2014 The influence of cave bacteria strains VDR5m and VDR5k on the spring wheat affection by root rot and leafspot disease *Vestnik KrasGAU* 9(96) 68-72

[7] Khizhnyak S V, Lankina E P, Iliyents I R 2009 Estimation of psychrophilic cave microorganisms efficiency in biological control of ordinary root decay of the grain-crops *Vestnik KrasGAU* 6(33) 49-52

[8] Sanin S S, Motovilin A A, Korneva L G, Zhokhova T P, Polyakova T M, Akimova E A 2011 Chemical protection of wheat from diseases during intensive grain production *Zashchita i karantin rasteniy* 8 3-8

[9] Lankina E P, Shevelev D I, Khizhnyak S V, Gurevich Yu L 2011 Research of the antitoxic properties of the iron hydroxide biogene nanoparticles concerning thiabendazole-tebuconazole fungicides *Vestnik KrasGAU* 11(62) 129-33

[10] State catalog of pesticides and agrochemicals, approved for use on the territory of the Russian Federation 2020 (Moscow: Ministry of Agriculture of the Russian Federation)

[11] Interstate standard. Seeds of crops. Methods for the determination of disease infection. Agricultural seeds. Methods for determination of disease infestation GOST 12044-93

[12] Khizhnyak S V, Puchkova E P 2019 *Mathematical methods in agroecology and biology*: studies (Krasnoyarsk: State Agrar. Un-ty) p 240