Key words: spring wheat, variety, resistance genes, disease resistance, yellow(stripe) rust, molecular screening, molecular markers.

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M.M. Bekezhanova, N.Zh. Sultanova*

[1] *"Kazakh Research Institute of Plant Protection and Quarantine after Zh. Zhiembaev" LLP, Almaty, The Republic of Kazakhstan, madina.bekezhanova.80@mail.ru*; nadira.sultanova@mail.ru*

THE FUNGICIDES EFFECT TESTING ON FLAX AND LENTILS SEED INFECTION IN THE LABORATORY CONDITIONS

Abstract

In recent years, research on the study of flax diseases has not been conducted in Kazakhstan and Russia. Research on diseases and pests of flax in the CIS countries is devoted to applied issues aimed at evaluating the effectiveness of preparations for pre-sowing seed treatment, monitoring the spread of diseases and pests, and assessing their impact. Research on flax seeds in different parts of the world is especially important because the response of cultivars to fungal pathogens can vary regionally due to the presence and/or development of new strains of the pathogen. The article presents the research results on the influence of fungicides on seed infection of flax and lentils in laboratory conditions. The data from phytoexamination of lentil and flax seeds showed that these crops were dominated by fungi from the genera Fusarium and Alternaria, and bacterial exudate was also noted with a frequency of occurrence ranging from 57.1% to 85.7%. Evaluation of the effectiveness of seed dressing in a controlled laboratory environment showed that all tested preparations, including Selest Top 312.5, s.c. (thiamethoxam, 262.5 g/l + difenoconazole, 25 g/l + fludioxonil, 25 g/l), Lamador, s.c. (prothioconazole, 250 g/l + tebuconazole, 150 g/l), and Olimp, s.c. (flutriafol, 75 g/l + thiabendazole, 50 g/l + imazalil, 15 g/l), were highly effective against Fusarium spp. and Alternaria spp.

Key words: *phytoexamination, flax, lentil, fungicide, microorganisms, diseases, seeds, isolates."*

Introduction

In the last 10 years, the area under oilseeds has doubled: from 1.2 million hectares in 2009 to 2.9 million hectares in 2019. The increase in sown areas of oilseeds was achieved by expanding the areas of flax by 5 times, soybeans by 2 times, and safflower by 39%. According to the Committee on Statistics of the Ministry of Economy of Kazakhstan, the sown area of oilseeds in Kazakhstan for the 2020 harvest increased by 14% compared to the previous year, reaching a record 2.838 million hectares for the country. Statistics show that in the structure of sown areas, the largest sector is occupied by oilseed flax. For instance, in 2018, 1.1 million hectares were sown with this crop, compared to 869.7 thousand hectares the previous year. Furthermore, there is a 47% increase in the area allocated for rapeseed cultivation in the farms of Kazakhstan. Flax is an economically important industrial crop in the Republic of Kazakhstan, cultivated on an area of 654 thousand hectares, with an average yield of 8 centners per hectare and a gross harvest of 490 thousand tons. The demand for flax is constantly growing [1].

In recent years, in the Republic of Kazakhstan, there has been a significant increase in acreage under oilseeds. For example, the area for sowing and growing flax has almost doubled. For Kazakhstan, the cultivation of flax has become one of the most important components of agribusiness [2]. However, despite the significant increase in the area of demanded agricultural crops, the yield of many of them remains low. Depending on weather conditions, crop losses of agricultural crops, especially oilseeds, from pests, diseases, and weeds reach 20–30% or even more [3]. For example, flax Alternaria blight, caused by Alternaria lini Dey, is the main fungal disease that significantly reduces the quantity and quality of seeds, leading to yield reductions of 18–43%. The disease was first discovered on flower buds in Kanpur, Uttar Pradesh, in 1933. The causative agent persists in seeds, soil, and plant debris. It is possible to combat the disease using favorable crop rotation, optimal sowing dates, removal of plant residues, soil solarization, resistant varieties, and pre-sowing seed treatment with chemical and biological agents [5–11].

In Kazakhstan and Russia, research on flax diseases has been limited in recent years. Research on diseases and pests of flax in the CIS countries is primarily focused on applied issues, such as evaluating the effectiveness of pre-sowing seed treatment [11] and monitoring the spread of diseases and pests and their impact [12; 13]. Research on flax seeds in different parts of the world is particularly important because the response of cultivars to fungal pathogens can vary regionally due to the presence and/or development of new strains of the pathogen."

Materials and methods

The research was conducted at the “Kazakh Research Institute of Plant Protection and Quarantine named after Zh. Zhiyembayev” LLP. To determine the presence of fungi, flax and lentil seeds were grown in four replicates in a humid chamber at a temperature of 25°C [7, p. 71] on potato dextrose agar and incubated for 8 days [14, 15].

The evaluation of fungicidal activity was carried out on nutrient media (potato-glucose agar and potato-dextrose agar) with the addition of fungal preparative forms. Incubation was conducted at room temperature, and fungicidal activity was assessed by measuring the diameter of the growth zone of micromycetes. The control group involved the development of fungi on a nutrient medium without the addition of preparative forms. This experiment was repeated three times [16].

The fungal microflora of the seeds was determined following established methodological guidelines. Seed treatment with isolates was carried out using a moistened method. The effectiveness of preparative forms (isolates) was determined by assessing the degree of suppression of fungal microflora on a nutrient medium [17, 18]. In light of these procedures, the objective of this study is to conduct a phytoexamination of seeds and, specifically, to investigate the impact of fungicides on seed infection of flax and lentils under laboratory conditions.

Results/discussion

"The main diseases of oilseed flax include fusarium, anthracnose, ascochytosis, and rust. Disease intensity depends on the virulence of the pathogen, weather conditions, and the vulnerability of the variety. Seed material has a significant influence on the yield volume and its quality. Even when flax seeds are infected by 10-15%, there is a decrease in yield. Diseases can cause serious reductions in lentil yield and its quality. The most effective method for managing diseases is implementing the correct crop rotation. Chemical treatments are also effective when applied at the early stages of the disease or as a preventive measure. The most important diseases include fusarium wilt (Fusarium oxysporum f. sp. lentis), ascochytosis (Ascochyta fabae f. sp. lentis), anthracnose (Colletotrichum spp.), rust (Uromyces viciaefabae), root rot (Fusarium spp., Rhizoctonia solani), and others.

The results of phytoexamination of lentil and flax seeds showed that these crops were dominated by fungi from the genus Fusarium and Alternaria. Bacterial exudate was also noted with a frequency of occurrence ranging from 57.1% to 85.7%. The fungicidal activity of three seed treater fungicides was studied. Evaluation of the effectiveness of fungicidal preparations in laboratory conditions on a nutrient medium showed that all tested preparations were highly effective against fungi of the genus Fusarium spp. and Alternaria spp. isolated from flax seeds and lentils (Table 1).

The laboratory phytopathological analysis of flax and lentil seeds was conducted in 2022. The analysis results revealed high contamination of seed material, ranging from 14.2% to 85.7% of affected plants. The value of $P<0.05$ is critical. It says that it is possible to correctly compare the average values of the dependent variable by this factor.

Table 1 – Lentils and flax seeds microorganisms isolation frequency (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

Crop	Microorganisms isolated, %				
	Fusarium	*Alternaria*	*Aspergillus*	*Penicillium*	Bacterial exudate
Lentils	28,5	71,4	0,0	14,2	57,1
Flax 1/1	14,2	14,2	0,0	28,5	85,7
P value, factor crop	<0.05	<0.05	<0.9	<0.05	<0.05

The phytoexamination data of lentil and flax seeds revealed a predominant presence of Fusarium and Alternaria fungi, along with the noted occurrence of bacterial exudate with a frequency ranging from 57.1% to 85.7% (see pictures 1-2). It is important to note that saprophytic fungi, such as Alternaria, can reduce germination ability, while anomorphic fungi like Fusarium can increase the risk of seed rot.

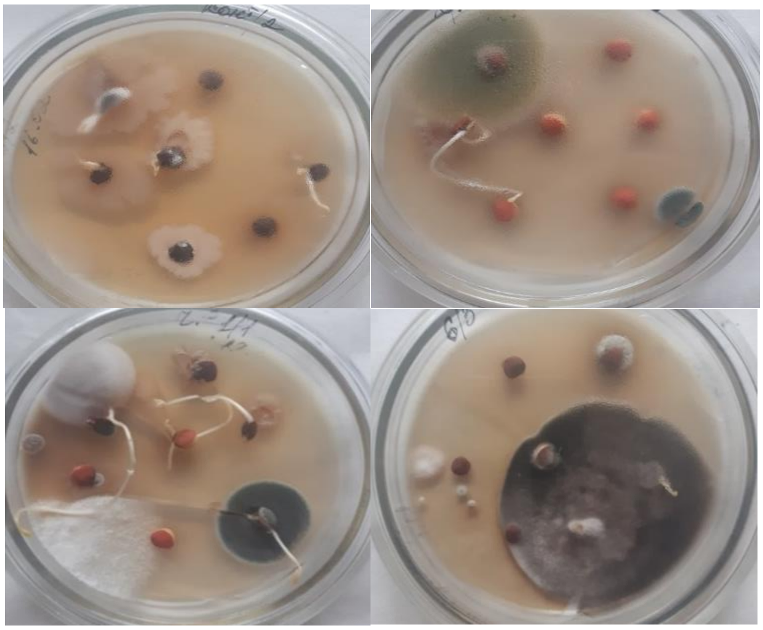

Figure 1 – Lentil seed samples on nutrient media (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

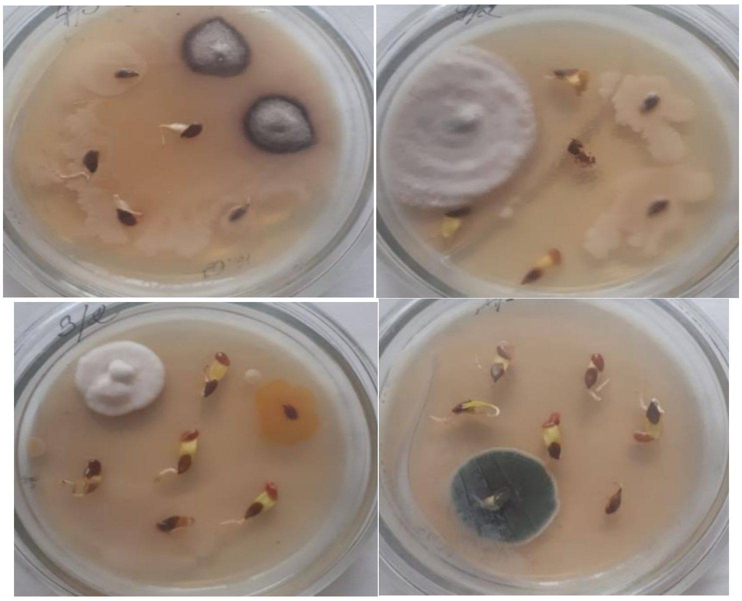

Figure 2 – Flax seed samples on nutrient media (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

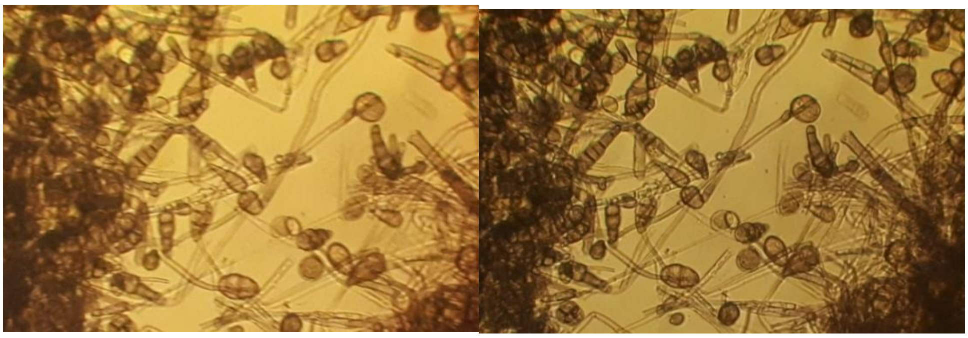

Figure 3 –*Alternaria* spp. fungi conidium extracted from lentil seed (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

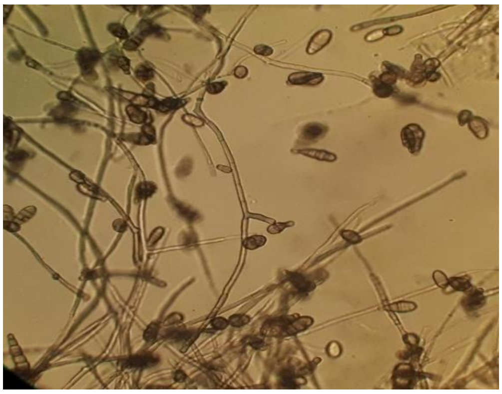

Figure 4 – *Altemaria linicola* Neerg. fungi conidium extracted from flax seed (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

The results of seed phytoexpertize showed that flax and lentil seeds were mainly infected by pathogenic and saprophytic microflora. However, the negative effects of diseases can be avoided, if the seed material is disinfected in time.

The results of seed phytoexamination revealed that both flax and lentil seeds were primarily infected by pathogenic and saprophytic microflora. However, the negative effects of these diseases can be avoided through timely seed disinfection.

To assess their effectiveness against seed infection, several fungicides were evaluated in laboratory conditions. The study focused on the fungicides' impact on the growth and development of pathogenic fungi. The following fungicides, applied during pre-sowing seed treatment, were investigated: Celest Top 312.5, s.c. (thiamethoxam, 262.5 g/l + diphenoconazole, 25 g/l + fludioxonil, 25 g/l), Lamador, s.c. (prothioconazole, 250 g/l + tebuconazole, 150 g/l), and Olymp, s.c. (flutriafol, 75 g/l + thiabendazole, 50 g/l + imazalil, 15 g/l). Both seeds and strains of phytopathogenic fungi extracted from flax and lentils were used as test subjects. The resistance of the crop's fungal pathogens to these fungicides was evaluated on agar media (potato dextrose agar) by adding fungicide concentrations of 1 ppm, 10 ppm, and 100 ppm, as well as on fungicide-free media (control)."

Figure 5 – flax seeds on nutrient medium without fungicide (control) (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

Figure 6 – flax seeds on nutrient medium with fungicides(Kazakh Research Institute of Plant Protection and Quarantine, 2023)

a b

Figure 7 – flax seeds on nutrient medium:
a) fungicide-free (control); b) with fungicide(Kazakh Research Institute of Plant Protection and Quarantine, 2023)

a b

Figure 8 – lentil seeds on nutrient medium:
a) fungicide-free (control); b) with fungicide (Kazakh Research Institute of Plant Protection and Quarantine, 2023)

The pictures show that the chemicals effectively inhibited the growth and development of phytopathogenic and saprophytic fungi on seeds.

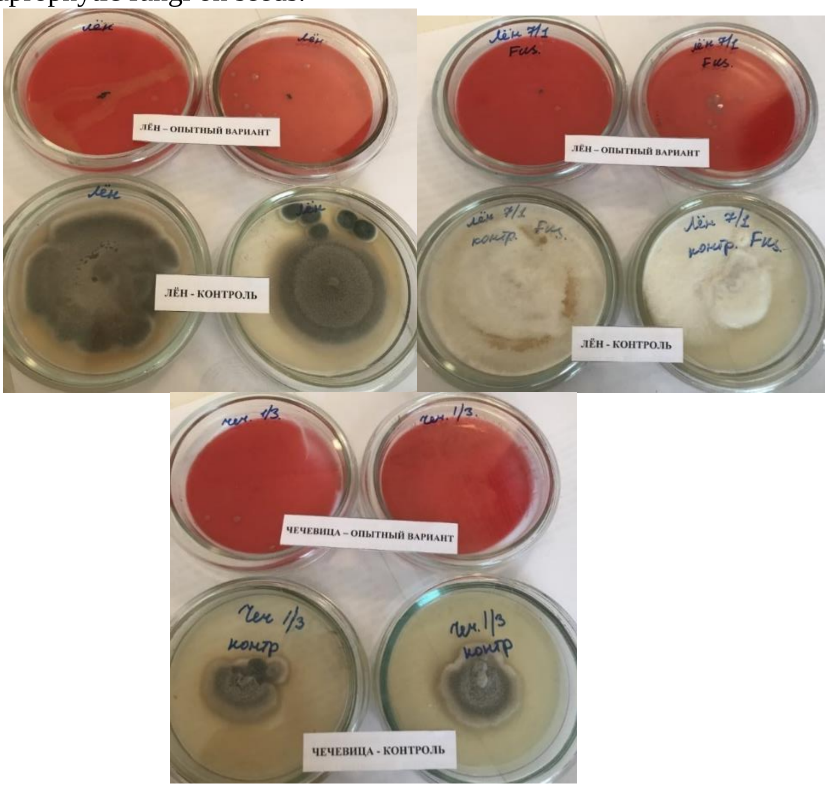

Figure 9 - Suppression of radial phytopathogenic fungi colonies growth by fungicide addition

The results demonstrated the suppression of radial colony growth in all tested fungal species when fungicides were added. The evaluation of fungicide effectiveness in laboratory conditions on nutrient media revealed that all the tested preparations—Celest Top 312.5, s.c. (thiamethoxam, 262.5 g/l + diphenoconazole, 25 g/l + fludioxonil, 25 g/l), Lamador, s.c. (prothioconazole, 250 g/l + tebuconazole, 150 g/l), and Olymp, s.c. (flutriafol, 75 g/l + thiabendazole, 50 g/l + imazalil, 15 g/l)—were highly effective against fungi of Fusarium spp. and Alternaria spp.

Conclusion

The results of phytoexamination of lentil and flax seeds showed that the seeds of these crops were dominated by fungi from the genus *Fusarium, Alternaria*, and bacterial exudate was also noted with a frequency of occurrence of 57.1-85.7%. The fungicidal activity of 3 seed treater fungicides was studied. Evaluation of the effectiveness of fungicidal preparations in laboratory conditions on a nutrient medium showed that all tested preparations were highly effective against fungi of the genus *Fusarium* spp. and *Alternaria* spp. isolated from flax seeds and lentils.

The article was written based on the results of research as part of the implementation of the Targeted Financing project for 2021-2023: BP 267, according to the scientific and technical program of the Ministry of Agriculture of the Republic of Kazakhstan BR 10764960 "The Development and improvement of an integrated system for the protection of fruit, vegetables, cereals, fodder and legumes and plant quarantine".

In conclusion, the phytoexamination of lentil and flax seeds revealed a dominance of fungi from the genus Fusarium and Alternaria, with the additional presence of bacterial exudate at a frequency ranging from 57.1% to 85.7%. The study assessed the fungicidal activity of three seed treater fungicides, and the evaluation of their effectiveness in laboratory conditions on a nutrient medium demonstrated that all tested preparations were highly effective against fungi of the genus Fusarium spp. and Alternaria spp. isolated from flax seeds and lentils.

Acknowledgements. This article is based on the results of research conducted as part of the implementation of the Targeted Financing project for 2021-2023: BP 267, in accordance with the scientific and technical program of the Ministry of Agriculture of the Republic of Kazakhstan, BR 10764960, titled "The Development and Improvement of an Integrated System for the Protection of Fruits, Vegetables, Cereals, Fodder and Legumes, and Plant Quarantine."

References

1. Gosudarstvennaya programma razvitiya agropromyshlennogo kompleksa Respubliki Kazakhstan na 2017–2021 gody. Astana. – 21 s.

2. Len maslichnyj — ehto nakhodka dlya uslovij Kazakhstana (APK-Inform: Itogi № 12(30). [EHlektronnyj resurs]. - 2018. - URL: https://www.apk-inform.com)

3. Kudryavtsev N.A. Zashhita l'na. // Zashhita i karantin rastenij. - 1999. -№ 3. S. 40.

4. Dey P.K. An Alternaria blight of linseed of plant. Indian J Agri. Sci 1933; 111:881-896.

5. Rani V.D., Sudini H. Management of soilborne diseases in crop plants: An overview. International Journal of Plant, Animal and Environmental Sciences 2013;3(4):156-164.

6. Singh V., Lal M., Kumar S., Ali M., Singh J. Management of Alternaria blight of linseed with sowing dates and host resistance. Universe of Emerging Technologies and Science 2015;2(5):1-4.

7. Patel N., Desai P., Patel N., Jha A., Gautam H.K. Agronanotechnology for Plant Fungal Disease Management: A Review, International Journal of Current Microbiology and Applied Sciences 2014;3(10):71-84.

8. Ramakant, Chauhan M.P., Singh R.B. Screening of linseed genotypes against Alternaria blight and bud fly. Crop Res 2008;35(1&2):124-127.

9. Biswas S.K., Shanker U., Kumar S., Kumar A., Kumar V., Lal K. Impact of bio-fertilizers for management of spot bloch disease, growth, and yield contributing parameter of wheat. Journal of Pure and Applied Microbiology 2015;9(4):3025-3030.

10. Bajbusenov K.S., Konysbaeva D.T., Bekenova SH. SH. Fitosanitarnaya otsenka ehffektivnosti preparatov predposevnogo dejstviya na posevakh l'na maslichnogo (Linum Usitatissimum L.) v usloviyakh lesostepnoj zony Severnogo Kazakhstana // 3i: intellect, idea, innovation-intellekt, ideya, innovatsiya. – 2020. – №. 2. – S. 65–73.

11. Bedlovskaya I.V. i dr. Zashhita l'na maslichnogo ot boleznej i vreditelej v usloviyakh tsentral'noj zony Krasnodarskogo kraya // EHntuziasty agrarnoj nauki. – 2019. – S. 171–172.

12. Kurilova D.A. Rasprostranyonnost' boleznej na maslichnom l'ne v usloviyakh tsentral'noj prirodno-klimaticheskoj zony Krasnodarskogo kraya //Sbornik materialov Vserossijskoj (natsional'noj) nauchno-prakticheskoj konferentsii. – 2019. – S. 469–471.

13. Nekhvedovich S.I., Vojtka D.V. Fitopatologicheskaya situatsii v posevakh l'na maslichnogo v usloviyakh Respubliki Belarus' i otsenka vredonosnosti dominiruyushhikh boleznej //Zemledelie i selektsiya v Belarusi. – 2020. – №. 56. – S. 66–74.

14. Yadav G.K., Kumar D., Maurya N., Sah D., Chaube A.K., Kumar A., Kumar A. and Singh P.K. Alternaria blight of linseed (Linum usitatissimum L.) and its chemical management: A comprehensive review //IJCS. – 2021. – T. 9. – №. 2. – P. 596-602. DOI: 10.22271/chemi.2021.v9.i2i.11882.

15. Agrios, G.N. 2005. Plant Pathology. Fifth Edition. Elsevier Academic Press. London, 952 r.

16. Farkhutdinov R.G., Nabeeva R.A., Urazbakhita N.A., Korobova A.V., KHajrullina R.R., Abuzglina R.I., YAmaleeva A.A., Ibragimov A.G. Sravnitel'naya otsenka fungitsidnoj aktivnosti preparatov i ikh vozdejstvie na gormonal'nuyu sistemu, morfogenez i produktivnost' rastenij pshenitsy // Sovremennye problemy nauki i obrazovaniya. – 2015. – № 2-2

17. Naumova N.A. Analiz semyan na gribnuyu i bakterial'nuyu infektsiyu. A. - 1970. – 207 s.

18. Kiraj Z., Klement Z., SHojmoshi F., Veresh J. Metody fitopatologii / M.: Kolos, 1974. - 344 s.

М.М. Бекежанова*, Н.Ж. Султанова

ТОО «Казахский НИИ защиты и карантина растений им. Ж. Жиембаева», г. Алматы, Республика Казахстан, madina.bekezhanova.80@mail.ru; nadira.sultanova@mail.ru*

ИЗУЧЕНИЕ ВЛИЯНИЯ ФУНГИЦИДОВ НА СЕМЕННУЮ ИНФЕКЦИЮ ЛЬНА И ЧЕЧЕВИЦЫ В ЛАБОРАТОРНЫХ УСЛОВИЯХ

Аннотация

В Казахстане и России в последние годы не проводились исследования по изучению болезней льна. Исследования по болезням и вредителям льна-долгунца в странах СНГ посвящены прикладным вопросам, которые направлены на оценку эффективности препаратов для предпосевной обработки семян, мониторинг распространения болезней и вредителей и их вредоносности. Повторное использование семян льна в разных частях мира особенно важно, поскольку реакция сортов на грибные патогены может варьироваться в зависимости от региона из-за присутствия и/или развития новых штаммов патогена.

В статье приведены результаты исследования по изучению влияния фунгицидов на семенную инфекцию льна и чечевицы в лабораторных условиях. Данные фитоэкспертизы семян чечевицы и льна показали, что на семенах этих культур преобладали грибы из рода *Fusarium, Alternaria,* также отмечался бактериальный экссудат с частотой встречаемости – 57,1-85,7%.

Оценка эффективности протравителей семян в лабораторных условиях на питательной среде показала, что все испытанные препараты: селест топ 312,5, к.с. (тиаметоксам, 262,5 г/л + дифеноконазол, 25 г/л + флудиоксонил, 25 г/л), ламадор, к.с. (протиоконазол, 250 г/л + тебуконазол, 150 г/л) и олимп, к.с. (флутриафол, 75 г/л + тиабендазол, 50 г/л + имазалил, 15 г/л) были высокоэффективны в отношении грибов рода *Fusarium spp.* и *Alternaria spp.*

Ключевые слова: фитоэкспертиза, лен, чечевица, фунгицид, микроорганизмы, болезни, семена, изоляты.

М.М. Бекежанова*, Н.Ж. Сұлтанова

«Ж. Жиембаев атындағы Қазақ өсімдік қорғау және карантин ҒЗИ» ЖШС, Алматы қ., Қазақстан Республикасы, madina.bekezhanova.80@mail.ru; nadira.sultanova@mail.ru*

ЗЕРТХАНАЛЫҚ ЖАҒДАЙДА ЗЫҒЫР МЕН ЖАСЫМЫҚТЫҢ ТҰҚЫМДЫҚ ИНФЕКЦИЯСЫНА ФУНГИЦИДТЕРДІҢ ӘСЕРІН ЗЕРТТЕУ

Аңдатпа

Соңғы жылдары Қазақстан мен Ресейде зығыр аурулары бойынша зерттеулер жүргізілмеген. ТМД елдеріндегі талшықты зығыр аурулары мен зиянкестері бойынша зерттеулер тұқымдарды себер алдындағы өңдеуге арналған препараттардың тиімділігін бағалауға, аурулар мен зиянкестердің таралуын және олардың зияндылығын бақылауға бағытталған қолданбалы мәселелерге арналған. Әлемнің әртүрлі бөліктерінде зығыр тұқымын қайта пайдалану әсіресе маңызды, өйткені саңырауқұлақ қоздырғыштарына сорттардың әсері патогеннің жаңа штаммдарының болуына және/немесе дамуына байланысты аймаққа байланысты өзгеруі мүмкін.

Мақалада зертханалық жағдайда зығыр мен жасымықтың тұқымдық инфекциясына фунгицидтердің әсерін зерттеу нәтижелері келтірілген. Жасымық пен зығыр тұқымдарына фито-сараптама нәтижесінде бұл дақылдардың тұқымдарында *Fusarium, Alternaria* тұқымдасының саңырауқұлақтары басым екенін көрсетті, сонымен қатар 57,1 – 85,7%-ға дейін бактериялық экссудат байқалды.

Зертханалық жағдайда қоректік ортада тұқым өңдейтін препараттардың тиімділігін бағалау нәтижесі барлық сыналған препараттар: селест топ 312,5, к.с. (тиаметоксам, 262,5 г/л + дифеноконазол, 25 г/л + флудиоксонил, 25 г/л), ламадор, к. с. (протиоконазол, 250 г/л + тебуконазол, 150 г/л) және олимп, к.с. (флутриафол, 75 г/л + тиабендазол, 50 г/л + имазалил, 15 г/л) *Fusarium spp.* және *Alternaria spp.* саңырауқұлақ туыстарына қатысты жоғары тиімділік көрсетті.

Кілт сөздер: фитоэкспертиза, зығыр, жасымық, фунгицид, микроағзалар, аурулар, тұқымдар, изоляттар.

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Н.М. Орынбаев[1], М.К.Алдабергенов[2]*

*[1]Казахский национальный исследовательский аграрный университет, Алматы, Республика Казахстан, nmaratovich@mail.ru**
[2] Научно-производственный центр Агроинеженерий, Алматы, Республика Казахстан, mk.aldabergenov@mail.ru

НОВЫЕ МЕТОДЫ ПЕРЕРАБОТКИ ОРГАНИЧЕСКИХ ВЕЩЕСТВ ДЛЯ ПРОИЗВОДСТВА НОВОЙ ПРОДУКЦИИ ИЗ ОТХОДОВ

Аннотация

Приведены результаты анализа метода переработки органических отходов и производства новой продукции, а также качество входных и выходных продуктов.

Рассчитаны показатели процесса пиролиза отходов в зависимости от степени нагревания и температуры обработки биомассы.

Приведены результаты анализов проводенной для определения содержания влаги, количество летучих веществ в составе биоугля и для определения углерода в составе биоугля, для дальнейшего использования биоуголь в внесении в почву. Продукты для получения биоуголь были привезены с разных регионов Франции.

Условия проведения анализа соответствует с требованиями установленной к лабораторным исследованиям, при этом подобрана нижеследующие показатели вещества и процессов: масса образца ≈ 30 (мг); температура 900 (°С); скорость нагрева 10 (°С.мин^{1}); время пребывания 60 (мин); атмосфера N_2/Air; скорость потока газа 100 (мл.мин$^{-1}$)

Процесс пиролиза заключается в преобразовании органических веществ под действием нагрев в инертной атмосфере, исходя из чего установлено при температуре 350…400 ^{0}С, минимальная показатели нагревания 35…40 град ^{0}С/мин., и максимальная производительности биоугля, которая повышает насыпная плотность, агрегатная устойчивость, гидравлическая проводимость, способность удержание воды и питательных веществ, емкость катионного обмена почвы, pH почвы.

Приведены результаты добавления полученных биоугла в почву, вызывает изменения физических, химических и микробиологических свойств почвы и повышения пористость, насыпная плотность, агрегативная устойчивость, гидравлическая проводимость, способность удержания воды и питательных веществ, емкость катионного обмена почвы, pH почвы, состав и микробная активность в конечном результате приведет к повышению плодородья.

Ключевые слова: *пиролиз, биоугол, биомассы, вакуумная печь, нагревание биомассы, пористость, насыпная плотность питательных веществ, почва и экологические состояния, природная среда.*

Введение

Сельское хозяйство как способствует изменению климата, так и зависит от изменения климата. ЕС намерен сократить выбросы парниковых газов в сельском хозяйстве и