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THE EFFECT OF FUNGICIDES

on the development of diseases and soybean yield in the Forest-Steppe of Ukraine

Goal. *To study the effectiveness of modern fungicides against the most common diseases of soybeans during the growing season and their effect on crop productivity in the Forest-Steppe of Ukraine.* **Methods.** *Field, phytopathological, statistical. The experiments were carried out in the farms of the Kyiv region, belonging to the Forest-Steppe zone of Ukraine. Spraying of soybean crops was carried out twice during the growing season in the phases of budding-beginning of flowering (51—55) and the formation of beans (71—75). Determined the development of diseases, the effectiveness of fungicides, crop yield.* **Results.** *The most common diseases of soybeans in the Forest-Steppe zone of Ukraine have been identified: Alternaria, downy mildew, Fusarium wilting, Septoria, and bacterial blight. The species composition of diseases and the degree of their development were largely influenced by the weather conditions of the growing season. The investigated fungicides Abacus mk.e. (pyraclostrobin, 62.5 + epoxiconazole, 62.5), Amistar Extra 280 SC, (azoxystrobin, 200 + cyproconazole, 80), Acanto Plus 28 c.s. (picoxystrobin, 200 g/l + cyproconazole, 80 g/l), Coronet 300 SC (trifloxystrobin, 100 g/l + tebuconazole, 200 g/l), as well as Impact K preparations, c.s. (flutriafol, 117.5 g/l + carbendazim, 250 g/l) and Koside 2000 w. g. (copper hydroxide, 350 g/kg) at the recommended application rates effectively limited the development of most fungal pathogens. The highest protective effect of 69.8—78.9% of fungicides was shown against downy mildew of soybeans, the lowest — 31.7—42.2% against Alternaria, which had the highest development in comparison with other diseases. Fungicide Koside 2000 w. g. at the level of 67% limited the development of bacterial diseases. The use of fungicides had a positive effect on the yield of soybeans. Due to the limitation of the development of diseases, the soybean yield increased by 21.2—30.3%, depending on the variant of the experiment.* **Conclusions.**

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The use of fungicides significantly affected the limitation of the development of the most common soybean diseases in the Forest-Steppe of Ukraine. The effectiveness of the studied modern fungicides against peronospora, fusarium wilting, septoria was at the level of 60.2—78.9%. Fungicides most effectively controlled the development of downy mildew, less effectively — the development of Alternaria. The limitation of soybean diseases when using fungicides contributed to an increase in its yield by an average of 0.7—1.0 t/ha.

soybeans; diseases; fungicides; efficiency; yield

Soybean (*Glycine max* L.) is one of the most common legumes and oilseeds in world agriculture. In Ukraine in recent years there has been a tendency to expand the area under this crop. Currently, the area under soybeans is 1.6 million hectares. Ukraine remains in the top ten soybean producers in the world and ranks 8th among them, producing 4.5 million tons of seeds in 2019 and 2020. This interest of farmers is explained by the high profitability of soybean production. The yield of the recommended varieties is 3.2—4.0 t/ha [1]. Extremes of extensive management, monoculture and other factors create favorable conditions for the dominance of pests. Annual studies constantly confirm the presence in the soybean seed material of a complex of pathogens of fungal and bacterial origin. As a result, sources of seed infection gradually accumulate [2].

Soybeans are affected by about 100 species of pathogens that cause significant damage and can manifest themselves at different stages of growth and development of the plant — from seed germination to full maturity. Pathogens of fungal and bacterial diseases cause a decrease in soybean yield by an average of 25—30%, and with epiphytic

development can destroy up to 50% of the seed crop [3]. There are 25 known diseases in the United States that pose a constant threat to this culture. The causative agents of three of them — bacteria, nineteen — fungi and three — viruses. In China, six of the eight most common diseases are caused by fungi. There are 23 known soybean diseases in Ukraine, 16 of them are fungal [4].

Diseases reduce the energy of seed germination and germination, liquefy crops, weaken plants, reduce the photosynthetic surface and productivity of cultivated plants, worsen the quality of the crop. Pathogenic fungi are able to synthesize toxins, which leads to a decrease in food and feed properties of products, and can also cause poisoning of humans and animals [5].

As a result of researches the complex of diseases of this culture is revealed. Among soil infections, the most common and harmful are root rot, caused mainly by fungi of the genus *Fusarium* (*F. oxysporum, F. solani, F. sambucinum, F. avenaceum, F. gibbosum*, etc.), the development of the disease exceeded the threshold for all years of research and was 70% or more. Fusarium wilt develops more than 70% in arid conditions. Bacterial burns (up to 35.8%), downy mildew (37.0%), septoria (32.5%) are widespread among leaf and stem infections. There was a significant correlation between the development of bacterial burns and warm humid conditions ($r = 0.74 \pm 0.21$). Studies indicate a significant spread of diseases in soybean crops and the need to develop a set of protective measures to protect against them [6].

Soybeans are the main crop grown in the United States, but are susceptible to many diseases that cause significant crop losses each year. According to the Journal of Integrated Pest Management (2020), their impact depends on many factors, including the environment, production practices, selection of varieties on susceptibility to disease. Soybean diseases such as stem rot, root rot, sudden death syndrome and stem rot (sclerotinia) are a recurring threat that can be strongly influenced by environmental factors. [7]. The disease usually occurs when there are three components of the triangle of the pathological process — a susceptible host, a virulent pathogen, a favorable environment.

In the conditions of the Central Forest-Steppe of Ukraine, according to our research, *Alternaria tenuis* Nees, *Peronospora manshurica* Sydow., *Fusarium oxysporum* Schecht and *Pseudomonas syringaine* ping. Other diseases include ascochytosis (*Ascochyta sojicola* Abramov), septoria (*Septoria glycines* Hemmi), viral and non-communicable diseases, the spread of which was insignificant [8].

The species composition of phytopathogenic objects annually differs significantly depending on soil and climatic conditions, variety, agricultural techniques. Due to climate change, diseases that until recently did not pose a significant threat to crops (*Alternaria*, *Fusarium* wilt, bacterial diseases) are becoming highly harmful. Diseases are widespread in years with excessive rainfall and sharp fluctuations in daily temperatures, under conditions of growing soybeans after poor predecessors (sunflower, canola, buckwheat), as well as in monoculture, for shallow tillage, crop thickening, unbalanced plant nutrition incompetent selection of fungicides. It should be noted that the level of disease of soybean crops largely depends on the amount of weediness of crops and pest damage [3, 5, 9].

The effectiveness of soybean protection against diseases depends on knowledge of many factors: the biological characteristics of pathogens, their harmfulness, signs of damage, the timing of dominance in crops, the rate of spread of infection and more. Protective measures should be carried out on the basis of operational phytosanitary assessment of soybean crops. To do this, it is necessary to conduct phytopathological monitoring of agrocenoses during the soybean growing season with the diagnosis of phytopathogens [10—12].

In Ukraine, soybeans are most often sown continuously. Therefore, during the period of branching, the culture covers the field with a thick carpet, creating ideal conditions for the development of fungal infections, which are stored in the seeds, on the soil surface and on the plant remains of the predecessor. In recent years, there has been an intensive spread of the pathogen of powdery mildew in different regions of Ukraine [1, 11].

According to John C. Rupe, Johnny Mason (2017), the detection of crop diseases by remote sensing can have a significant economic and environmental impact on crop disease management. Visible and nearinfrared (NIR) spectroscopic remote sensing can detect crop changes due to disease. [13].

Of great importance in the system of protection of soybeans from diseases, along with the use of pesticides is the treatment of seeds with bacterial preparations using nitrogen-fixing bacteria. Seed treatment with preparations based on nodule bacteria (Azotobacterin, Biomag-soy, Optimize) has a healing effect on seeds, promotes the formation of a stronger root system, increases nodulating activity, resistance of plants to environmental changes and crop yields. Scientists Vorobey, Kukol, Kotz (2020) conducted a study to determine the toxicity of fungicides on nodule bacteria *Bradyrhizobium japonicum* in pure culture [14]. They found that most strains of these bacteria are low-sensitivity to the studied fungicides in the recommended doses.

Along with the introduction of selection-genetic, agro-technical and organizational-preventive measures to protect soybeans from diseases, an important place belongs to the use of fungicides [15—18]. Noteworthy are the innovative fungicides that contain strobilurin compounds. They not only effectively protect soybeans from many fungal diseases, but also promote the hidden mechanisms of protective reactions of plants, also called physiological effects (increasing plant resistance to abiotic and biotic stresses, increasing photosynthetic and enzymatic activity, increasing nitrogen efficiency and protein synthesis, etc.). These effects reduce the impact of stressful environmental conditions on crop formation.

High efficiency of fungicides will be provided on condition of timely forecasting of emergence of diseases and preventive drawing of drug on plants. To do this, soybean crops are inspected every 5—6 days after the appearance of the first leaves, select the required number of plants for analysis, create provocative conditions and determine the presence of pathogens and, if necessary, apply the appropriate fungicide. In the field, plants are often affected by several pathogens, so fungicides with different active substances are used for protection [2]. Experts recommend at least one fungicidal treatment on ultra-early (up to 80 days) and early (up to 100 days) soybean varieties.

To ensure clear control of plant diseases with a longer growing season, it is best to carry out double application of fungicides. In both cases, fungicidal treatment of soybeans is best done prophylactically, before infecting plants, taking into account the prognosis of the disease [2].

Japanese scientists Hajime Akamatsu, Masayasu Kato, Sunao Ochi and others (2019) investigated the use of three fungicides to inhibit the development of root rot on different soybean varieties. Under their influence, the development of the disease was limited, and the protective effect of the tested agrochemicals persisted for at least 28 days after seed treatment [19].

In recent years, fungicides have appeared on the market of plant protection products, which are characterized by translaminar and systemic distribution of the drug on the plant. Such fungicides include innovative products of leading companies (Abacus®, Acanto Plus®), which are able to control the most harmful diseases of soybean leaves and beans: fusarium wilt and verticillium wilt, powdery mildew, rust, ascochitosis, septoria, downy mildew and rhizomes. According to many researchers, the highest level of control over the development of fungal diseases on soybean crops was obtained with the use of fungicides that have a wide range of fungicidal action [17]. According to Kiersten Wisé (2015), the rating of fungicides is based on the level of effectiveness of disease control and does not necessarily reflect the increase in yield from application of the product [16].

Researchers of the United States of America conducted field studies to study the effects of the fungicides prothioconazole plus trifloxystrobin and pyraclostrobin. on the development of soybean diseases. During the years of research, the disease did not have significant pressure on the culture. Therefore, the use of fungicides did not affect soybean yield. Only drugs with active substances prothioconazole plus trifloxystrobin led to a decrease in plant damage and increased income [18].

Most researchers claim that the use of fungicides on soybeans can significantly increase crop yields. According to Likhochvor and Shcherbachuk (2014), the highest yield of soybeans was obtained by using the fungicide Coronet (0.8 l/ha) in the budding phase and Abacus (1.5 l/ha) in the flowering phase [15].

Thus, soybeans are affected by many infectious diseases throughout the growing season. In order to effectively protect crops, it is necessary to constantly conduct phytosanitary monitoring and make timely decisions on protective measures.

The purpose of research is to determine the effectiveness of modern fungicides against the most common soybean diseases in the Forest-Steppe of Ukraine and their impact on crop yields.

Material and methods of research. The work was carried out in 2013—2018 in the farms of Kyiv region. Soil — low-humus chernozem, humus content 2.6%, pH — 5.8.

Soybeans were sown with a special selection drill at the rate of 600 thousand seeds per 1 ha, row spacing 25 cm. The area of the experimental plots was 20 m^2, the repetition was 4 times. The experiments were performed according to the method of testing and application of pesticides [20]. The seeds were not pre-treated.

During the soybean growing season, the spread and development of diseases in the dynamics were determined according to generally accepted methods. To do this, inspected 20 plants in a row in 3—4 equidistant places in one area. Disease records were performed on known scales [21]. The prevalence and development of soybean diseases were determined on varieties of early maturity Madison, Moravia, Muse and Siverka. Experiments to evaluate the effectiveness of fungicides were performed on the variety Madison.

Fungicides with different active substances (based on strobilurins and triazoles) and different mechanism of action were used in the experiments. First of all, these are innovative drugs Abacus, m.e. (pyraclostrobin, 62.5 g/l

+ epoxiconazole, 62.5 g/l), Amistar Extra 280 SC, s.c. (azoxystrobin, 200 g/l + cyproconazole, 80 g/l), Acanto Plus 28, s.c. (picoxystrobin, 200 g/l + cyproconazole, 80 g/l), Coronet 300 SC, s.c. (trifloxystrobin, 100 g/l + tebuconazole, 200 g/l), as well as drugs Impact K, s.c. (flutriafol, 117.5 g/l + carbendazim, 250 g/l) and Coside 2000, v.g. (copper hydroxide, 350 g/kg). Treatment of soybean plants with fungicides was carried out twice a season: in the phase of budding-beginning of flowering (BBCH 51—55) and the formation of beans (71—75).

Determined the development and spread of diseases, the effectiveness of fungicides, crop yields.

Statistical processing of research results was carried out using the computer program «Statgraphic plus».

Results and discussion. In soybean crops during the years of research the most common diseases were: *Alternaria tenuis* Nees, *Alternaria alternata* (Fr.) Keisl.), Peronosporosis (*Peronospora manshurica* Sydow.), Fusarium wilt (*Fusarium oxysporum* Schecht.), Bacteriosis in the form bacterial burns (*Pseudomonas syringae pv. glycinea* Coerper). Septoria (*Septoria glycines* Hemmi.), Ascochitosis (*Ascochyta sojaecola* Abramov.) And viral diseases (*Bean yellow mosaic virus, Soybean mosaic virus*) were less common. %, downy mildew and fusarium wilt — an average of 20%, bacterial blight — about 10%, septoria — up to 5%, other diseases — up to 5%. The highest development of diseases was recorded in the phase of budding — flowering. In the germination phase — the first true leaf to a greater extent manifested bacteriosis and fusarium wilt, which is apparently associated with seed infection.

Weather conditions had a significant impact on the development of diseases. The analysis of meteorological indicators showed that in all years of research the average daily air temperature during the growing season exceeded the normative indicator by an average of 1.3—2.8°C, and the moisture deficit averaged 40%. The driest years were 2015 and 2017, when only 146 mm and 53 mm of precipitation fell against the required 365 mm. Precipitation over the decades and months of the growing season was mostly uneven. The highest amount of precipitation, as a rule, fell in May-June, and the lowest — in July-August.

It is characteristic that in conditions of sufficient humidity and a significant difference between night and day temperatures, downy mildew became more developed. Uneven humidity and high average daily temperatures contributed to the development of Alternaria and Fusarium wilt. Alternaria, which until recently was not of great economic and environmental importance, in recent years has been characterized by significant development from the beginning to the end of the soybean growing season. This can be explained by the wide specialization and plasticity of pathogens to environmental conditions.

According to the results of surveys, Alternaria had the highest development in 2014 and 2018 — 38.5 and 30.0%, downy mildew — in 2014 — 24.0%, Fusarium wilt in 2014 and 2015 — 26.6 and 14.0%, septoria — in 2014 and 2018 — 13.2 and 12.2%. Bacteriosis in the form of bacterial burns on soybean crops was detected in 2014, 2015 and 2018 with the development of the disease 6.2—8.5% (Table 1). As you can see, in 2014, with excessive moisture, most soybean diseases with the highest rates of their development compared to other years.

The dynamics of soybean diseases depending on meteorological factors, namely the hydrothermal coefficient, is shown in Figure 1. Weather conditions significantly influenced the development of soybean diseases. With excessive rainfall in May and warm weather (GTK = 2.4), the first signs of soybean disease were observed by many diseases — bacteriosis, fusarium wilt, Alternaria, downy mildew.

There has been a significant increase in the rate of disease development in July in the flowering phase — the beginning of the formation of beans (stage 66—69) at a GTK of 1.45. In August, with increasing temperature and decreasing precipitation (GTK = 0.75), a significant increase in the infectious process occurred with the development of pathogens of *Alternaria* and *Fusarium* wilt, which are characterized by broad ecological plasticity.

The application of fungicides significantly affected the development of soybean diseases. According to the obtained results, all studied fungicides most effectively controlled the development of downy mildew: the effectiveness of fungicides during the growing season was 69.8—78.9%. The studied fungicides also inhibited the development of fusarium wilt at the level of 60.4—77.5%. The effectiveness of fungicides against septoria averaged 58.2—62.3%. The lowest efficiency of fungicides was recorded against soybean Alternaria — 31.7—42.2%, the development of which was the highest compared to other diseases (Table 2).

The most effective soybean mycoses were controlled by the fungicides Akanto Plus 28, s.c., (picoxystrobin, 200 g/l and cyproconazole, 80 g/l), 0.75 l/ha and Abacus mk.e., (pyraclostrobin, 62.5 g/l + epoxiconazole, 62.5 g/l), 1.75 l/ha. The combination of active substances with different mechanisms of action provides a powerful preventive and curative effect against fungal pathogens. Bacterial diseases were effectively limited by the fungicide Coside 2000, w.g., 2.5 kg/ha, the technical efficiency of which averaged 67.0%.

Effective restriction of the parasitic microbiota during the growing season helped to increase soybean yield. The grain yield in the experimental variants was 4.0—4.3 t/ha against 3.3 t/ha in the control, which is 21.2—30.3% higher (Table 2).

Discussion. Soybean yield is largely limited by the development of a complex of diseases of fungal, bacterial and viral origin. According to observations in the Forest-Steppe zone of Ukraine, mycorrhizae are dominated by Alternaria, downy mildew, Fusarium wilt, Septoria, bacterial blight among bacterial diseases, and yellow and wrinkled soybean mosaic among viral diseases. The species composition of pathogens, their distribution and development are greatly influenced by agricultural cultivation techniques, weather conditions, susceptibility of the variety. Diseases are widespread in years with excessive rainfall and sharp fluctuations in daily temperatures due to unbalanced plant nutrition and untimely implementation of soybean protection measures. An important place in

1. Development of soybean diseases and meteorological indicators in the years of research (on average for May-August)

Years	Average daily air temperature, °C *	Precipitation, mm **	Disease development,%					
			Alternaria	Peronosporosis	Fusarium	Septoria	Bacteriosis	Others
2014	18.8	335,0	38.5	24.0	26.6	13.2	8.5	5.0
2015	19.3	19.3	28.5	15.2	14.0	11.2	6.2	3.5
2016	19.5	231.0	20.4	4.0	8,5	7.5	–	2.8
2017	19.2	46.5	22.8	2.0	5.2	10.0	–	6.5
2018	19.8	216.8	30.0	4.5	–	12.2	8.4	10.8

Notes: «–» — not found; * — norm of average daily air temperature — 17,2°C; ** — precipitation rate 304 mm

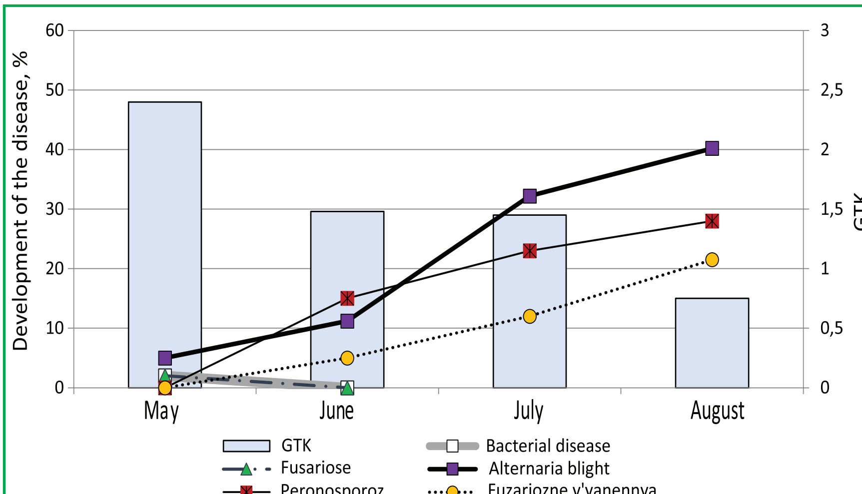

Fig. 1. Dynamics of development of soybean diseases on the background GTK (Madison variety, 2014)

the system of protection of soybeans from diseases belongs to the use of fungicides.

Analysis of the literature and the results of our own research show that the best results are provided by combined broad-spectrum fungicides that are able to control the most harmful diseases of soybean leaves and beans. Such fungicides include drugs based on strobilurins and triazoles, namely Abacus mk.e. (pyraclostrobin, 62.5 g/l + epoxiconazole, 62.5 g/l), Amistar Extra 280 SC, s.c. (azoxystrobin, 200 g/l + cyproconazole, 80 g/l), Acanto Plus 28 SC (picoxystrobin, 200 g/l and cyproconazole, 80 g/l), Coronet 300 SC, s.c. (trifloxystrobin, 100 g/l + tebuconazole, 200 g/l), which is characterized by translaminar and systemic distribution of the drug in the plant. The effectiveness of these drugs with double spraying was against soybean downy mildew 70.5—78.9%, against *Fusarium* wilt — 64.2—77.5, against septoria — 61.0—62.3%. A slightly lower protective effect of fungicides was manifested against soybean Alternaria — 37.1—42.2%. Obviously, this is due to the high degree of development of *Alternaria*, wide specialization and environmental plasticity of pathogens. The development of bacterial diseases was effectively restrained by the fungicide Coside 2000, w.g. — at the level of 67.0.

The results of research show that the effective restriction of the development of soybean diseases has had a positive effect on its yield. With the use of fungicides, soybean yield increased by 0.7—1.0 t/ha, or by 21.2—30.3% compared to the control. The highest yields were obtained with the use of fungicides Abacus mk.e., 1.75 l/ha and Acanto Plus 28 SC, 0.75 l/ha, which provided the highest protective effect against soybean mycoses.

CONCLUSIONS

During the years of research, soybean diseases in the Forest-Steppe zone of Ukraine were dominated by *Alternaria*, downy mildew, *Fusarium* wilt, Septoria, and bacterial burns, the degree of development of which largely depended on weather conditions during the years of research. Combined modern broad-spectrum fungicides Abacus m.e., Amistar Extra 280 SC, s.c., Acanto Plus 28 s.c., Coronet 300 SC, s.c., Impact K, s.c. in the recommended norms, the costs effectively limited the development of most mycoses. The studied fungicides provided the highest protective effect against soybean downy mildew, the lowest — against *Alternaria*. Fungicide Coside 2000, w.g. provided high technical efficiency against bacterial diseases.

Due to the limitation of soybean diseases, a significantly higher grain yield was obtained: 0.7—1.0 t/ha more compared to the control.

2. The effectiveness of fungicides against soybean diseases (Medison variety, Kyiv region, 2014—2018)

A variant of the experiment	Technical efficiency,%					Crop	
	Alternaria	Peronosporosis	Fusarium wilt	Septoria	Bacteriosis	t/ga	% to control
Control (without drugs) *	28.5*	17.0*	10.6*	10.4*	8.5*	3.3	—
Abacus mk.e., 1.75 l/ha	42.2	73.3	75.7	61.8	—	4.3	130.3
Acanto Plus 28 s.c., 0.75 l/ha	40.2	**78,9**	**77.5**	**62.3**	—	4.3	130.3
Amistar Extra 280 SC, s.c., 0.75 l/ha	38.7	70.7	64.2	58.4	—	4.2	127.3
Impact K, s.c., 0.8 l/ha	38.7	71.0	60.4	60.2	—	4.1	124.2
Coronet 300 SC, s.c., 0.8 l/ha	37.1	70.5	71.7	61.6	—	4.0	121.2
Coside 2000, w.g., 2.5 kg/ha	40,3	69.8	66.8	58.2	67.0	4.2	127.3
(SSD) The smallest significant difference $_{05}$	—	—	—	—	—	0.51	—

Note: * — disease development, % (on average during the growing season

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Вплив фунгіцидів на розвиток хвороб і урожайність сої в Лісостепу України

Мета. *Дослідити ефективність сучасних фунгіцидів проти найпоширеніших хвороб сої в період вегетації та їх вплив на урожайність культури в Лісостепу України.* **Методи.** *Польові, фітопатологічні, статистичні. Досліди проводили в господарствах Київської області, що відносяться до зони Лісостепу України. Обприскування посівів сої проводили двічі впродовж вегетації у фази бутонізація — початок цвітіння (стадія за ВВСН 51—55) та утворення бобів (стадія 71—75). Визначали розвиток хвороб, ефективність дії фунгіцидів, урожайність культури.* **Результати.** *Визначено найбільш поширені хвороби сої в зоні Лісостепу України: альтернаріоз, пероноспороз, фузаріозне в'янення, септоріоз, бактеріальний опік. На видовий склад хвороб та ступінь їхнього розвитку значною мірою впливали погодні умови вегетаційного періоду. Досліджувані фунгіциди Абакус, мк.е. (піраклостробін, 62,5 г/л + епоксиконазол, 62,5 г/л), Амістар Екстра 280 SC, к.с. (азоксістробін, 200 г/л + ципроконазол, 80 г/л), Аканто Плюс 28, к.с. (пікоксістробін, 200 г/л + ципроконазол, 80 г/л), Коронет 300 SC, к.с. (трифлоксістробін, 100 г/л + тебуконазол, 200 г/л), а також препарати Імпакт К, к.с. (флутріафол, 117,5 г/л + карбендазім, 250 г/л) і Косайд 2000, в.г. (гідроксид міді, 350 г/кг) у рекомендованих нормах витрати ефективно обмежували розвиток більшості грибних патогенів. Найвищий захисний ефект (69,8—78,9%) фунгіциди проявили проти пероноспорозу сої, найнижчий (31,7—42,2%) — проти альтернаріозу. Фунгіцид Косайд 2000, в.г. обмежував розвиток бактеріальних хвороб на рівні 67%. Застосування фунгіцидів позитивно вплинуло на урожайність культури. Завдяки обмеженню розвитку хвороб урожай зерна сої збільшився на 21,2—30,3% залежно від варіанту досліду.* **Висновки.** *Застосування фунгіцидів суттєво впливало на обмеження розвитку найпоширеніших хвороб сої в умовах Лісостепу України. Ефективність дії досліджуваних сучасних фунгіцидів проти пероноспорозу, фузаріозного в'янення, септоріозу становила 60,2—78,9%. Найбільш ефективно фунгіциди контролювали розвиток пероноспорозу, менш ефективно — розвиток альтернаріозу. Обмеження хвороб сої за використання фунгіцидів сприяло підвищенню її врожайності в середньому на 0,7—1,0 т/га.*

соя; хвороби; фунгіциди; ефективність; урожайність

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Влияние фунгицидов на развитие болезней и урожай сои в Лесостепи Украины

Цель. *Исследовать эффективность современных фунгицидов против наиболее распространенных болезней сои в период вегетации и их влияние на урожайность культуры в Лесостепи Украины.* **Методы.** *Полевые, фитопатологические, статистические. Опыты проводили в хозяйствах Киевской обл., относящихся к зоне Лесостепи Украины. Опрыскивание посевов сои проводили дважды в течение вегетации в фазы бутонизация — начало цветения (51—55) и образование бобов (71—75). Определяли развитие болезней, эффективность действия фунгицидов, урожайность культуры.* **Результаты.** *Определены наиболее распространенные болезни сои в зоне Лесостепи Украины: альтернариоз, пероноспороз, фузариозное увядание, септориоз, бактериальный ожог. На видовой состав болезней и степень их развития в значительной мере влияли погодные условия вегетационного периода. Исследуемые фунгициды Абакус, мк.е. (пираклостробин, 62,5 г/л + эпоксиконазол, 62,5 г/л), Амистар Экстра 280 SC, к.с. (азоксистробин, 200 г/л + ципроконазол, 80 г/л), Аканто Плюс 28 к.с. (пикокситробин, 200 г/л + ципроконазол, 80 г/л), Коронет 300 SC, к.с. (трифлоксистробин, 100 г/л + тебуконазол, 200 г/л), а также препараты Импакт К, к.с. (флутриафол, 117,5 г/л + карбендазим, 250 г/л) и Косайд 2000, в.г. (гидроксид меди, 350 г/кг) в рекомендованных нормах расхода эффективно ограничивали развитие большинства грибных патогенов. Самый высокий защитный эффект (69,8—78,9%) фунгициды проявили против пероноспороза сои, самый низкий (31,7—42,2%) — против альтернариоза, что имел наивысшее развитие по сравнению с другими болезнями. Фунгицид Косайд 2000 в.г. ограничивал развитие бактериальных болезней на уровне 67%. Применение фунгицидов положительно повлияло на урожайность сои. Благодаря ограничению развития болезней урожай сои увеличился на 21,2—30,3% в зависимости от варианта опыта.* **Выводы.** *Применение фунгицидов существенно влияло на ограничение развития наиболее распространенных болезней сои в условиях Лесостепи Украины. Эффективность действия исследуемых современных фунгицидов против пероноспороза, фузариозного увядание, септориоза составила 60,2—78,9%. Наиболее эффективно фунгициды контролировали развитие пероноспороза, менее эффективно — развитие альтернариоза. Ограничение болезней сои при использовании фунгицидов способствовало повышению ее урожайности в среднем на 0,7—1,0 т/га.*

соя; болезни; фунгициды; эффективность; урожайность

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