С.Сейфуллин атындағы Қазақ агротехникалық университетінің **Ғылым жаршысы (пәнаралық)** = **Вестник науки** Казахского агротехнического университета им. С.Сейфуллина (**междисциплинарный**). - 2020. - №1 (104). - Р.90-97

ASSESSMENT OF THE BIOLOGICAL AND ECONOMIC EFFICIENCY OF FUNGICIDES AGAINST EARLY BLIGHT OF POTATO IN THE CONDITIONS OF KARAGANDA REGION

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Annotation

. In this article the results of the fungicides test against Early blight of potato is described. There were used fungicides with different active substances (mancozeb + dimethomorph; pyraclostrobin + boscalid) against Early blight of potato variety Udacha grown in a moderately arid warm hilly-plain steppe zone of Central Kazakhstan, in a subzone of dark chestnut soils of “Naydorovskoe LLP”. The features of the defeat and intensity of the defeat of potatoes by alternariosis in the growing season of 2019 are shown. Probable species of the genus Alternaria have been identified in potato plantings. The biological and economic efficiency of fungicides was determined, yield increases were revealed with single and double application of fungicide.

Keywords: Early blight of potato, Alternaria, fungicides, mancozeb, dimetomorph, pyraclostrobin, boscalid, biological effectiveness, economic efficiency, yield increase

Potato has a high potential productivity, it can provide a harvest of more than 60t/ha [1]. The average potato yield in Kazakhstan is 19.04-19.79 t/ha, however it does not reach even half of the potential yield [2].

More than 100 types of pests can damage potato [3]. Loss of yield from them in the world is more than 30% annually [1]. The primary disease of potato is late blight. However, in Central Kazakhstan, alternariosis due to weather and climatic conditions in terms of severity can exceed late blight. In Russia during the years of epiphytotia, losses from alternariosis reach 30% [4]. Among the measures aimed at reducing potato crop losses from alternariosis, the main

ones are the cultivation of resistant varieties and the chemical method of plant protection. The importance of plant protection due to the concentration of potato production, cultivation in irrigated areas is even greater. Moreover, to prevent or suppress pathogen resistance, it is recommended to use fungicides with various types of action [5].

Objective: study of the spread and development of Alternariosis in planting potatoes, assessing the role of preventive treatments with fungicides in ensuring safety from loss of potato harvest during the growing season

To achieve the goals, the following tasks were set:

- to monitor the spread and development of airborne infections in potato plantings in the dark chestnut subzone of the steppe zone of Central Kazakhstan (Naydorovskoe LLP);
- identify the causative agent of Alternariosis in laboratory conditions by using wet chambers and isolation in a pure culture;
- determine the biological effectiveness of fungicides against Alternariosis in potato plantings;
- determine the yield of potato tubers depending on protective measures and the economic effectiveness of fungicides.

Materials and research methods

To fulfill the research objectives, field experiments on potato plantings in the moderately arid warm hilly-plain steppe zone of central Kazakhstan (Naydorovskoe LLP) were conducted. The soil of the experimental plot is dark chestnut, with heavy loamy texture, with a humus content of 2.0%, pH 7.5. The content of available nutrients (mg per 1 kg of soil): P2O5 2.28; K2O 32.66; N-NO3 1.79.

Experiment 1. The study of the biological and economic effectiveness of preventive treatment with fungicides against Early blight of potato.

Options: 1 mancozeb, 600 g/kg + dimetomorph, 90 g/kg, 69% ED, 2 kg/ha; 2 pyraclostrobin, 128 g/kg + boscalide, 252 g/kg , 38% w.d., 0.3 kg/ha; 3 Control without application. The spraying period is July 11.

Experiment 2. The study of biological and economic efficiency and double treatment with fungicide against Early blight of potato.

Options: 1 Pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d., 0.3 kg/ha; 2 Control (no application). The spraying period is July 29.

The repetition in the experiments was threefold, the size of the plots was 36 m². Spraying plants with a backpack sprayer was carried out with a rate of flow of working fluid at a rate of 200 l/ha. Potato variety Udacha.

During the performing accounting and observing inspection at the experimental hospital combined with the shuttle. The methodology generalized by V.G. Ivanyuk, S.A. Banadysev, G.K. Zhuromsky [6], recommended by G.Sukhoruchenkova, Dolzhenko [7], Hannibal F.B. [8] and other authors; Assessment of the biological and economic effectiveness of the preparations was carried out according to the recommended for testing pesticides

[8, 9]. Observations of the growth and development of potatoes and yield were determined according to the Gossortset method [10].

Potato tops were affected by diseases from the complete germination phase to its death using a 6-point rating scale, where 0 points – no symptoms of the disease, and 6 points — all leaves died out. The spread and development of diseases was determined 10, 18-20, 30 days after the treatment of plantings with fungicides. The calculation of biological effectiveness was carried out according to the modified Abbot formula.

The identification of pathogens was carried out in the laboratory of plant biotechnology of JSC «S. Seifullin Kazakh Agrotechnical University" with the creation of wet chambers in Petri dishes, isolation in pure cultures and microscopy.

Agricultural technology in the experiment

The cultivation of potatoes in the experimental plots was carried out in accordance with the agricultural technology adopted by the farm (with the exception of fungicidal treatments).

Statistical processing of the obtained yield data was carried out according to B.A. Dospechov [11]. A significance level of 5% was adopted ($P_{0.05}$). For statistical processing, the Sneedecor application statistics program was used.

Research results and discussion

Monitoring of the spread and development of potato diseases was carried out from the emergence of seedlings. The drought, established in the middle of the summer of this year for a long period, restrained the spread of fungal infection. At the beginning of the growing season, there was only a single manifestation of the infection transmitted by the tubers: blackleg, ring rot, and rhizoctonia. From the beginning of the third decade of July after regular irrigation by rain, rainfall, mainly rainfall, progression of airborne infection was noted. Dry leaves of Early blight with characteristic zonality in the form of concentric circles began to be found on individual leaves of the potato of the surface layer.

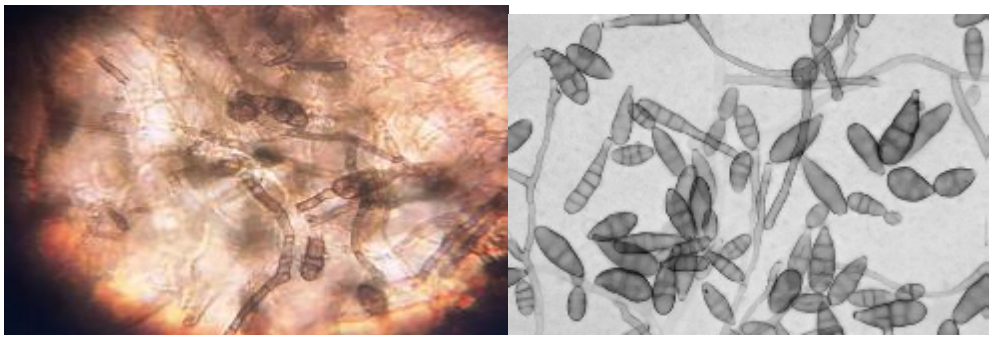
It should be noted that the manifestation of Early blight was in two forms. At the time of detection (in the budding phase), these were separate rounded zonal spots with concentric circles. At later infection, the initial manifestation was in the form of many small mostly angular spots located along the entire surface of the leaf blade. When the first signs of the disease appeared, the potato was in the phase of the end of budding - the beginning of flowering. In this phase, the spread of Early blight was single, in the range of 2.0-2.7%. The defeat of late blight was not detected.

With the onset of the phase of mass flowering, the spread and development of Early blight intensified. Hot weather combined with precipitation contributed to the mass appearance and development of the fungus. In the middle of the first ten days of August, distribution reached 47%, development averaged 10%. After the appearance of

small necrotic spots, the leaf was withered and folded into a tube.

Towards the end of the growing season on an aging tops, the spots of Early blight began to merge together. This led to necrotization of a significant leaf surface. In the third decade of August, diseased leaves began to turn yellow and dry. The death of individual plants from Early blight was observed. Sick and dead plants were a source of infection, nearby plants had a severe degree of damage. On average, the spread of the disease was 79%, the degree of damage was 20%. The defeat of late blight was a single, the number of diseased plants at the end of August did not exceed 5%.

Figure 1 shows as microscopy of plaque isolated on potato-glucose agar (PGA) and an illustration with an identified pathogen in AIPP [9].



a b

a - allocated conidia from plaque; b - identified conidia [9]

Figure 1 - Identification of the pathogen of Early blight

When inoculated on the KGA, both sterile and abundant spore colonies were formed. For comparison, images are provided with pathogens identified and in VIZR [9]. At earlier stages of potato development, microscopy of plaque from wet chambers and artificial nutrient media revealed conidia *Alternaria solani* more often. When analyzing plaque at the beginning of the death of the tops, conidia of *Alternaria alternata were* more often found. Identification of pathogens of Early blight and their features require further study [12, 13, 14].

The threshold for the appropriateness of applying active measures with the help of chemicals according to Polyakov et al. [5] against Early blight during the growing season is 12% of the defeat of the tops. As a preventive measure, on July 11, at the beginning of potato budding, according to the experimental design, fungicides were treated. At the time of spraying, there were no signs of Early blight and late blight on the aboveground organs of the potato. A weak manifestation of alternariosis and mainly in the control (without treatment) was found at the beginning of the third decade of July (spread of 2.3%, development within 0.05%), after repeated irrigation by irrigation. With a weak degree of plant

damage, it was not possible to determine the biological effectiveness on day 10 after treatment. Differences in the distribution and development of alternariosis in the use of fungicides were clearly identified 18 days after treatment, after precipitation at the beginning of the third decade of July.

ifferences in the spread and development of diseases 18 days after treatment with fungicides with a weak infectious load were significant. If 44.8% of plants were affected in the control, then in variants treated with fungicides, plants affected by Early blight were 1.9–4.3 times less (table 1).

Table 1 - The effect of preventive treatment with fungicides on the distribution and development of potato Early blight after 18 days (145 reference plants, processing July 11)

Option	Affected plants , pcs.	Preva-lence,%	Sum of frequencies	The intensity of the lesion,%	Biological efficiency, %
Mancozeb, 600 g/kg + dimetomorph, 90 g/kg, 69% East, (2 kg / ha)	20	13.8	436	4.0	56.0
Pyraclostrobin, 128 g/kg + boscalid, 252 gkg, 38% w.d. (0.3 l/ha)	15	10.3	283	2.6	75.0
Control (no application)	65	44.8	992	9.1	-

According to table 1, by the end of July, in the phase of flowering of potatoes, more than a third of plants had symptoms of alternariosis, the average degree of leaf damage was 9.1% in the control. On individual plants, the degree of damage has already reached the criteria for the threshold of harmfulness. It should be noted that after 18 days, the drug with the active substance mancozeb, 600 g / kg + dimetomorph, 90 g / kg with the preparative form is water-dispersible granules and with a consumption rate of 2 kg / ha, in biological effectiveness against alternariosis, it was noticeably inferior to the drug with the active substance is pyraclostrobin, 128 g / kg + boscalide, 252 g / kg, with the same formulation with a consumption rate of 0.3 kg / ha.

Thirty days after prophylactic treatment, the protective effect of the drugs was still observed. The drug Pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d. (0.3 kg / ha) during the growing season against Early blight on potato plantings was not inferior. On these options, the degree of damage to plants and on the thirtieth day was noticeably lower than on the control (without treatment) (table 2).

Table 2 - The effect of prophylactic treatment with fungicides on the distribution and development of potato Early blight after 30 days (142 plants analyzed, processing on July 11)

Option	Consumption rate, kg / ha	Affected plants, pcs.	Prevalence, %	Sum of frequencies	The intensity of the lesion,%
Mancozeb, 600 g/kg + dimetomorph, 90 g/kg, 69% WD,	2.0	91	64.1	1466	13.7
pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d.	0.3	70	49.3	1006	9.4
Control (no application)	-	118	83.3	1969	18.4

At the end of July, the affected leaves began to turn yellow. In the period of intense tuberization, damage to plants by Early blight above the severity threshold could have a noticeable negative effect on the processes of assimilation in the leaves. Affected potato plants represented a serious source of potato Early blight infection. On July 29, a second fungicide treatment was carried out. On potato plantings in the control variant, the development of the disease already exceeded the threshold of harmfulness.

Pyraclostrobin fungicide, 128 g/kg + boscalide, 252 g/kg, 38% EH, effectively restrained the development of Early blight. On the 10th day after the treatment, during the period of intensive distribution of Early blight with double use, the biological efficiency was 89.0% (table 3).

Table 3 - Biological effectiveness of fungicide against potato alternariosis 10 days after re-treatment (150 plants analyzed, processing July 11 + July 29)

Option	affected plants	Prevalence, %	Sum of frequencies	The intensity of the lesion,%	Biological efficiency,%
pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d., 0.3 kg / ha	24	16,0	374	2,8	89.0
Control (no application)	123	82,2	2360	25.7	-

20 days after the fungicide treatment (in mid-August), in the control without treatment with severe damage to alternariosis, not only the death of individual leaf sections was observed, but also the complete yellowing and death of the tops on separate potato bushes. The double-fungicide option continued to effectively suppress the spread and development of Early blight. The protective effect of fungicide against Early blight was also noticeably manifested on the 20th day after treatment, the biological efficiency indicator was at the level of 79.3% (table 4).

Table 4 - Biological effectiveness of fungicide against potato alternariosis 20 days after re-treatment (148 plants analyzed, processing July 11 + July 29)

Option	Affected plants, pcs.	Prevalence,%	Sum of frequencies	The intensity of the lesion,%	Biological efficiency, %
pyraclostrobin, 128 g/kg + boscalide, 252	37	25.0	699	6.3	79.3

g/kg, 38% w.d. 0.3 kg / ha					
Control (no application)	135	91.2	3386	30.5	-

On August 28, on the 30th day after processing on aging potato tops, the intensity of plant Early blight infection in the control without treatment significantly exceeded the severity threshold (Table 5). When twice preventive treatment of potato plantings with fungicide Pyraclostrobin, 128 g/kg + boscalid, 252 g/kg, 38% EH it was possible to maintain the assimilating aerial mass of plants almost until pre-harvest desiccation. One month after treatment, the number of affected plants was half that of the control (without treatment).

Table 5 - Biological effectiveness of fungicide against potato Early blight 30 days after treatment after double treatment (151 plants analyzed, processing July 11 + July 29)

Option	Affected plants , pcs.	Prevalence,%	Sum of frequencies	The intensity of the lesion,%
pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d. , about 3 kg / ha	68	45.0	2712	24.0
The control	151	100	3989	35.3

Short-term rainfall, irrigation irrigation at elevated temperatures in July and the first half of August were more favorable for the causative agent of alternariosis than for late blight.

The first signs of late blight on the lower leaves of a potato bush in the form of small brown vague spots began to appear in the third decade of August. The spread of the disease was within 5%, the development is weak. In August, the relatively frequent precipitation against the background of an elevated temperature regime did not contribute to the epiphytotic development of late blight.

For potatoes cultivated under irrigation in Central Kazakhstan, fungicidal treatments against alternariosis are necessary. The results of the studies showed that in the absence of protective measures against alternariosis, the yield loss of tubers can be 16.2-18.1% (table 6).

Table 6 - Effect of treatment with fungicides on potato tuber yield, Naydorovskoe, LLP 2019 g of .

Option	Consumption rate, kg / ha, l/ha	Harvest tubers t/ha	Deviations from control	
			t/ha	%
Single prophylactic treatment (processing 11 July)				
Mancozeb, 600 g/kg + dimetomorph, 90 g/kg, 69% WD,	2	23.0	2.0	9.5
pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d.	0.3	24.4	3.4	16,2
Control (no application) (for variant from 11 July)	-	21.0	-	-
NDS $_{(0.5)}$	-	3. 7	-	-

m (%)	-	3.49	-	-
Double processing (processing 11 July and 29 July)				
pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d.	0.3	31.9	4.9	18.1
Control (no application) (for variant from 29 July)	-	27.0	-	-
NDS (0.5)	-	3.27	-	-
m (%)	-	1.99	-	-

According to the data in table 6, with a single application of fungicides against Early blight, you can get positive deviations in the tuber yield from the control (without treatment). They amounted to 1.5-3.4 t/ha, but in the conditions of the year were unreliable. This is because in conditions of atmospheric drought 1-2 decades of July, Early blight was poorly developed in potato plantings (fungicide treatment was carried out on July 11). In the future, as the distance from the treatment period, with the progression of the disease, the protective effect of fungicides was not enough to ensure a significant increase in yield. The best results from fungicidal treatment were obtained with double use during the growing season of potatoes. pyraclostrobin, 128 g/kg + boscalide, 252 g/kg, 38% w.d., at a normal consumption rate of 0.3 kg / ha when used for prophylactic purposes, twice provided effective protection against Early blight. According to biological efficiency, the highest economic efficiency was 18.1% (an increase of 4.9 t / ha from the control level).

Conclusion

As a result of the selection and analysis of the affected potato leaves, the Alternaria solani and Alternaria alternate species were identified for the subzone of dark chestnut soils of the Karaganda region. This provision requires further research. In the absence of protective measures, leaf damage by alternariosis caused loss of potato harvest at the level of 16.2-18.1%. By biological and economic effectiveness, fungicide with the active substance pyraclostrobin, 128 g/kg + boscalide, 252 g/kg; east (0.3 kg/ha) with a single treatment showed better results than the drug with AI mancozeb, 600 g/kg + dimethomorph, 90 g/kg; east (2 kg/ha). However, a single prophylactic treatment carried out at the beginning of potato budding (July 11) was not enough to suppress the development of the disease in 2019. Intensive progression of alternariosis was observed from late July to early August. An additional crop of potato tubers from a single treatment with fungicides (2.0-3.4 t / ha) was within the limits of NDS_{05} (3.7). The use of the drug pyraclostrobin, 128 g/kg + boscalide, 252 g / kg, and.d.g. in the prevention of alternariosis of potato leaves was highly effective. (0.3 kg/ha) twice (after 10 days 89.0% and after 18-20 days 79.3%, respectively). Repeated processing on July 29 contributed to a significant increase in the yield of potato tubers (by 4.9 t / ha according to the variant with pyraclostrobin, 128 g/kg +

boscalid, 252 g/kg, IDG from the control level).

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ҚАРАҒАНДЫ ОБЛЫСЫ ЖАҒДАЙЫНДА КАРТОПТЫҢ АЛЬТЕРНАРИОЗ АУРУЫНА ҚАРСЫ ҚОЛДАНЫЛАТЫН ФУНГИЦИДТЕРДІҢ БИОЛОГИЯЛЫҚ ЖӘНЕ ШАРУАШЫЛЫҚ ТИІМДІЛІГІН АНЫҚТАУ

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Түйін

2019 жылдың вегетация кезеңі жағдайында Орталық Қазақстанның қоңыржай құрғақ жылы қыратты жазық дала зонасы қара қоңыр топырағында («Найдоровское» ЖШС) картоптың Удача сорты танабынан іріктелген залалданған картоп жапырақтарын іріктеу және талдауы нәтижесінде картоп альтернариозы қоздырғыштары *Alternaria solani* және *Alternaria alternate* анықталды. Биологиялық және шаруашылық тиімділігі бойынша пираклостробин әсер етуші заты бар, 128 г/кг + боскалид, 252 г/кг, с.д.г. (0,3 кг/га) фунгицидті манкоцеб ә.е. заты бар, 600 г/кг + диметоморф, 90 г/кг; в.д.г. (2 кг/га) фунгицидіне қарағанда жоғары тиімділік көрсетті. 2019 жыл жағдайында бір рет өңдеу кезінде картоптың қосымша түйнектер өнімі фунгицидті бір рет өңдеуде (2,0-3,4 т/га) ЕТА (3,7) шегінде болды. Пираклостробин, 128 г/кг + боскалид, 252 г/кг, с.д.г. (0,3 кг/га) препаратын екі рет қолдану (10 күннен кейін 89,0% және 18-20 күннен кейін 79,3% сәйкесінше) жоғарғы тиімділікті қамтамасыз етті және 4,9 т/га қосымша өнім алынды.

Түйінді сөздер: картоп альтернариозы, alternaria, фунгицидтер, манкоцеб, диметоморф, пираклостробин, боскалид, биологиялық тиімділік, шаруашылық тиімділік, қосымша өнім.

ОЦЕНКА БИОЛОГИЧЕСКОЙ И ХОЗЯЙСТВЕННОЙ ЭФФЕКТИВНОСТИ ФУНГИЦИДОВ ПРОТИВ АЛЬТЕРАНИРОЗА КАРТОФЕЛЯ В УСЛОВИЯХ КАРАГАНДИНСКОЙ ОБЛАСТИ

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Резюме

В результате отбора и анализа поражённых листьев картофеля, отобранных в посадках картофеля сорта Удача в умеренно засушливой тёплой холмисто-

равнинной степной зоне центрального Казахстана на темнокаштановых почвах (ТОО «Найдоровское») в условиях вегетационного периода 2019 года иидентифицированы виды возбудителя альтернариоза картофеля – *Alternaria solani и Alternaria alternate*. По биологической и хозяйственной эффективности фунгицид с действующим веществом пираклостробин, 128 г/кг + боскалид, 252 г/кг; в.д.г. (0,3 кг/га) показал более высокую эффективность, чем препарат с д.в. манкоцеб, 600 г/кг + диметоморф, 90 г/кг; в.д.г. (2 кг/га). В условиях 2019 года при однократной обработке фунгицидами дополнительный урожай клубней картофеля (2,0-3,4 т/га) оказался в пределах НСР (3,7). Высокую эффективность обеспечивало применение препарата с действующим веществом пираклостробин, 128 г/кг + боскалид, 252 г/кг, в.д.г. (0,3 кг/га) двукратно (через 10 дней 89,0% и через 18-20 дней 79,3 % соответственно), что обеспечило прибавку урожая 4,9 т/га.

Ключевые слова: альтернариоз картофеля, alternaria, фунгициды, манкоцеб, диметоморф, пираклостробин, боскалид, биологическая эффективность, хозяйственная эффективность, прибавка урожая.

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