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Использование одно- и многокомпонентных химических препаратов для обработки клубней картофеля

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Изучена эффективность применения протравителей клубней картофеля сорта Гала в Кировской области. Причинами снижения урожайности картофеля являются болезни, вредители и сорняки. При этом только болезни могут унести около 20% урожая. Из наиболее вредоносных болезней картофеля следует отметить фитофтороз, ризоктониоз, альтернариоз, антракноз, фузариоз, фомоз, обыкновенная парша и др. Опыты проводили в течение 2021–2023 гг. Объектом исследования были болезни картофеля: антракноз, ризоктониоз, обыкновенная парша на картофеле и фунгициды-протравители (Эместо Сильвер, КС; Селест Топ, КС; Флудимакс, КС). Учет поражения болезнями проводили согласно общепринятой методике. В начале вегетации биологическая эффективность применения препаратов была от средней до высокой и составила 34,5–96,3%. Наибольшая эффективность отмечена у комбинированных двух- и трехкомпонентных препаратов Эместо Сильвер и Селест Топ (88 и 96% соответственно). Выделились два препарата с наименьшим поражением к концу вегетации по обыкновенной парше – Эместо Сильвер и Селест Топ (13 и 19%). Наибольшая прибавка урожайности получилась у двухкомпонентного препарата Эместо Сильвер (8,3 т/га) и трехкомпонентного препарата Селест Топ (9,8 ц/га). Рекомендовано для получения высоких и стабильных урожаев картофеля и максимальной защиты от болезней (антракноз, парша) использовать многокомпонентные препараты с высокой биологической эффективностью, такие как Селест Топ, который в исследованиях обеспечил максимальную прибавку урожая.

Ключевые слова: болезни картофеля, парша, антракноз, урожайность, фенофаза, продуктивность

The use of single and multi-component chemical preparations for potato tuber treatment

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The efficiency of application of potato tuber dressing agents of the Gala variety in the Kirov region was studied. One of the reasons of potato yield reduction is diseases, pests and weeds. At that, only diseases can take away about 20% of the yield. Among the most harmful potato diseases are late blight, rhizoctoniose, early blight, anthracnose, fusarium, phoma disease, potato scab and other diseases. The experiments were conducted during 2021– 2023. The object of research were potato diseases: anthracnose, rhizoctoniose, potato scab on potato and mordant fungicides (Emesto Silver, SC; Celest Top, SC; Fludimax, SC). Disease incidence was recorded according to the generally accepted methodology. At the beginning of vegetation, the biological efficiency of the application of preparations was from me-

dium to high and amounted to 34.5–96.3%. The highest efficacy was observed for the combined two- and three-component formulations of Emesto Silver and Celest Top (88 and 96%, respectively). Two preparations with the lowest lesions by the end of the growing season for potato scab – Emesto Silver and Celest Top (13 and 19%) – stood out. The highest yield increase was obtained with two-component preparation Emesto Silver (8.3 t/ha) and three-component preparation Celest Top (9.8 c/ha). It is recommended to use multicomponent preparations with high biological efficiency, such as Celest Top, which provided maximum yield increase in the studies, to obtain high and stable potato yields and maximum protection against diseases (anthracnose, potato scab).

Keywords: potato diseases, potato scab, anthracnose, yield, phenophase, productivity

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INTRODUCTION

Potato is the most valuable agricultural field crop, the use of which is quite wide, as well as its application. This crop can be used fresh for medicinal purposes, but more in processed form for the production of mashed potatoes, chips, fries, animals for fodder. Potatoes are a valuable technical crop for the production of alcohol and starch. In Russia, about 14 million tubers of potatoes are sold, up to 1 million tons for thermal processing [1, 2].

In the world, the annual gross yield is about 330 million tons, while in Russia this figure is 37 million tons. Some varieties are capable of producing 50 tons of tubers/ha [3-5]. According to Rosstat, the area under potatoes is 1.07 million hectares with an average yield of 287.6 c/ha.

Losses from storage in Russian farms usually amount to 1.5 million tons, with export losses reaching up to 200 thousand tons[1] [6–9].

According to Flor's "gene-on-gene" theory, there is constant change and emergence of new races of pathogen in response to the changed conditions, including resistance of pathogens to a number of drugs to which resistance was once noted [10–12].

A number of diseases (anthracnose, phytophthora) show resistance to a number of used fungicides. Currently, the chemical method serves as a basis for pathogen control, but it is necessary to search for more effective and low-hazard preparations, as well as the creation of disease-immune varieties in order to reduce the pesticide load and obtain environmentally safe products for nutrition[2] [13–15].

The purpose of the research is to study the effectiveness of potato tuber dressing agents of the Gala variety in the Kirov region.

Research objectives:

1. Study of the prevalence of anthracnose, black leg, potato scab during the growing season after treatment of the tubers with fungicides-etching agents in different phenological phases of potatoes.

[1]*Zadvornev V.A., Porcev I.N., Sazhina S.V.* Integrated protection of potato varieties from pests and diseases in the Southern Trans-Urals // Priority directions of regional development. Collection of articles on the materials of the III All-Russian (national) scientific-practical conference, Kurgan, 2022, pp. 336–341.

[2]*Barkov V.A., Bukharova A.R., Zeiruk V.N.* Efficiency of new insecticide-fungicide etchant application on potatoes in the Moscow region // Actual problems of science and technology. Innovatika. Collection of scientific articles on the materials of VI International Scientific and Practical Conference, Ufa, 2021, pp. 37–48.

2. Analysis of the elements of potato productivity structure.

3. Identification of the yield increase of potato tubers when the tubers are treated with different preparations.

MATERIAL AND METHODS

Potatoes of the Gala variety of the 2nd reproduction were used as an object of research in the production experiment. Potatoes were planted in the field, newly introduced into the crop rotation, where no field crops of the 3rd year were cultivated.

The soil of the experimental plot was sod-podzolic, light and medium loamy by granulometric composition.

In the surveyed years, unstable weather was observed in June, from very warm to cold, mostly dry or with small, only occasionally heavy rains. During the month it was mostly dry or there were small, less often heavy rains, which were of spotty character. Precipitation during the month ranged from 40 to 60 mm.

In July, very warm and hot weather prevailed in the first half, in some areas with dry weather, mostly dry or with light, only occasionally heavy showers, while moderately warm and warm weather prevailed in the second half, with frequent, occasionally heavy and very heavy showers. The average monthly air temperature was 20.5–22.5 °C. As a result, from 100 to 130% of the norm fell during the month, depending on the year of study.

In August, the weather was unstable, from warm and moderately warm to cool, predominantly dry or with light precipitation, only in some days with heavy rains. As a result, the average monthly air temperature ranged from 15.1 to 16.7°C and was 0.5°C below the climatic norm.

The object of research were potato diseases: anthracnose, rhizoctoniose, potato scab and fungicides- mordants.

The time of planting was in the second ten-day period of May. Experiments were conducted during 2021–2023. The planting rate was 48 thousand pieces/ha [10, 11].

Control of disease damage was carried out according to the methodology [16]. The growth-regulating effect was taken into account in the phase of full sprouting of potatoes - II ten-day period of June.

The following preparations were investigated.

Fludimax, SC. The active ingredient (a.i.) of the seed dressing is fludioxonil (25 g/l). Fludioxonil inhibits germination of mycelium of the pathogens, causing disruption of osmotic pressure control in the cell. Compatible with most pesticides, except those with strongly alkaline or strongly acidic reaction.

Emesto Silver, SC. The active ingredient of the seed dressing is penflufen (systemic action) (100 g/l) and prothioconazole (systemic action) (18 g/l). Systemic-translaminar fungicide. It affects the pathogen in the mitochondria and endoplasmic reticulum. Spectrum of activity of Emesto Silver, SC seed dressing: rhizoctoniose (all forms), silver potato scab, potato scab, fusarium blight, anthracnose, phoma disease, rubbery rot.

Celest Top, SC. Combined insectofungicide potato tuber dressing agent for protection against a complex of pests of seedlings and diseases of fungal nature. It contains three active substances: thiamethoxam (262 g/l) – intestinal neonicotinoid against wireworm, Colorado potato beetle, difeconazole (25 g/l) – triazole compound of systemic action, fludioxonil (25 g/l) – systemic action of phenylpyrrole. The last two active ingredients are against rhizoctoniose, silver potatop scab, anthracnose, fusarium blight.

The experiment scheme included four variants:

1. Control (drug-free treatment).
2. Celest Top, 0.4 l/t.
3. Emesto Silver, 0.4 l/t.
4. Fludimax, 0.4 l/t.

RESULTS AND DISCUSSION

The obtained data on growth-stimulating effect are presented in Table 1.

The inhibitory effect of the preparations on plant height at early stages of potato development was found in the experiment – by 0.5–1.5 cm (18.56 cm in control), except for the preparation

Emesto Silver, where the height of the seedlings amounted to 19.34 cm (see Table 1).

Fungicides-etching agents had no inhibitory effect on the number of germinated tubers.

In the flowering phase, anthracnose was weakly developed in all variants of the experiment; Celest Top was the most effective in this case. Weak lesions (1%) were observed when treated with Fludimax and 2% with Emesto Silver (see Table 2).

Rhizoctoniose was absent in all variants of the experiment. The best protective effect against potato scab was provided by Celest Top preparation (1.1%), the greatest among the studied variants of potato tubers lesion is noted as a result of the treatment with Fludimax preparation (17,1%).

Табл. 1. Росторегулирующее действие фунгицидов протравителей в фазу полных всходов

Table 1. Growth-regulating effect of mordant fungicides in the phase of full shoots

Experiment option	Plant height, cm	Number of sprouting tubers/ha, thousand pcs.
1. Control (without treatment)	18,56	47,8
2. Celest Top, 0.4 l/t	17,04	48,0
3. Emesto Silver, 0.4 l/t	19,34	47,9
4. Fludimax, 0.4 l/t	18,06	47,7
LSD_{05}	5,9	7,6

Табл. 2. Распространение болезней в период вегетации (фаза цветения) (I декада июля)

Table 2. Spread of diseases during the growing season (flowering phase) in the 1st ten-day period of July

Experiment option	Anthracnose, %	Rhizoctoniose, %	Potato scab, %
1. Control (without treatment)	4	0	27,6
2. Celest Top, 0.4 l/t	0	0	1,1*
3 Emesto Silver, 0.4 l/t	2	0	3,0*
4. Fludimax, 0.4 l/t	1*	0	17,1*
LSD_{05}	2,9	–	4,03

Here and in Tables 3-7. * Probability level $P > 0,95$.

In the phase of the beginning of tuber formation it was noted that Celest Top again had an inhibitory effect on the development of all diseases (see Table 3). Noticeable infestation by potato scab was observed in the variant with Fludimax (21,6%).

Emesto Silver preparation contributed to insignificant rhizoctoniose lesions (2%) compared to the control (5,4%).

With the rainy weather in August, anthracnose and potato scab increased their harmfulness.

During the period of tuberization, anthracnose and potato scab harmfulness increased. Once again Celest Top showed its protective effect (see Table 4).

In the first ten-day period of September, the same tendency of the protective effect of the preparations on potatoes was observed; due to precipitation, the prevalence of anthracnose and potato scab increased. Anthracnose development varied from 5 to 13% (see Table 5).

The Emesto Silver preparation again showed a prevalence of rhizoctoniose on potatoes of 5%.

The infestation with potato scab by the end of vegetation in the experiment ranged from 13 to 45%.

Celest Top preparation markedly reduced infestation with potato scab (13%), in the variants with Fludimax preparation the lesion was 43%.

The potato crop is formed throughout the growing season from the germination phase to the formation of new crop tubers.

Табл. 3. Распространенность болезней в фазу клубнеобразования (III декада июля)

Table 3. The development of diseases in the tuber formation phase (3rd ten-day period of July)

Experiment option	Anthracnose, %	Rhizoctoniose, %	Potato scab, %
1. Control (without treatment)	12,5	5,4	32,7
2. Celest Top, 0.4 l/t	1,5*	0	2,3*
3. Emesto Silver, 0.4 l/t	8,0	2,0	4,0*
4. Fludimax, 0.4 l/t	8,0	0	21,6
LSD_{05}	6,5	5,2	11,5

Табл. 4. Распространенность болезней картофеля в фазу начала роста клубней (II декада августа)

Table 4. Prevalence of potato diseases in the phase of tuber growth initiation (2nd ten-day period of August)

Experiment option	Anthracnose, %	Rhizoctoniose, %	Potato scab, %
1. Control (without treatment)	18	7,8	42,0
2. Celest Top, 0.4 l/t	5*	0	8,0*
3. Emesto Silver, 0.4 l/t	8*	3,5	12,0*
4. Fludimax, 0.4 l/t	10	0	32,0
LSD_{05}	6,9	6,7	12,4

Табл. 5. Развитие болезней в фазу интенсивного роста клубней (I декада сентября)

Table 5. Development of diseases in the phase of intensive tuber growth (1st ten-day period of September)

Experiment option	Anthracnose, %	Rhizoctoniose, %	Potato scab, %
1. Control (without treatment)	19	8,2	58,0
2. Celest Top, 0.4 l/t	5*	0	13,0*
3. Emesto Silver, 0.4 l/t	9	5,0	19,0*
4. Fludimax, 0.4 l/t	13	0	43,0
LSD_{05}	8,2	6,1	15,6

Record of the elements of productivity structure showed that the number of stems in the variety Gala varied from 3.9 to 5.0 pieces (see Table 6).

Stem formation was higher with the use of Emesto Silver and Fludimax. The highest tuber formation in the variants was provided by Fludimax and Celest Top preparations, 11.0 and 10.6 tubers, respectively. The average tuber weight per bush was higher in Emesto Silver and Celest Top variants, respectively 0.93 and 0.96 kg/bushel. Average tuber weight was higher in Fludimax treatment (72.0 g) and Celest Top (90.5 g). Yield records showed that this index varied markedly from 1.83 to 9.7 t/ha.

There is a decrease in the efficiency of the preparation due to its one-component nature, e.g. Fludimax contributed to yield increase by 1.85 t/ha. Yield gains were higher with Emesto Silver 8.3 t/ha (two-component) and Celest Top 9.8 t/ha (three-component).

Табл. 7. Урожайность картофеля при проведении контрольной копки в переводе на 1 т/га

Table 7. Potato yield during the control digging in terms of 1 t/ha

Experiment option	Potato yield, t/ha	Yield increase, t/ha +/-
1. Control (without treatment)	36,3	0
2. Fludimax, 0.4 l/t	39,2	+2,9
3. Emesto Silver, 0.4 l/t	44,5*	+8,3
4. Celest Top, 0.4 l/t	46,8*	+9,8
LSD_{05}	6,2	

Табл. 6. Элементы структуры продуктивности картофеля сорта Гала

Table 6. Elements of the Gala potatoes productivity structure

Experiment option	Number of stems, pcs.	Number of tubers on one bush, pcs.	Average weight of tubers from one bush, kg	Average tuber weight, g
1. Control (without treatment)	3,9	10,2	0,76	74,0
2. Celest Top, 0.4 l/t	4,0	10,6	0,96	90,5
3. Emesto Silver, 0.4 l/t	4,5	10,4	0,93	88,0
4. Fludimax, 0.4 l/t	5,0	11,0	0,83	72,0
LSD_{05}	2,7	5,2	1,1	24,5

CONCLUSIONS

1. At the beginning of vegetation 100% protection against anthracnose was provided by Celest Top, slightly reducing it by the end of vegetation, which is 1.7 times higher than in case of treatment with single-component preparation Fludimax.

2. Emesto Silver was slightly inferior to Celest Top, its biological efficiency amounted to 52.3% by the end of vegetation.

3. Based on the calculation of the biological efficacy of the studied preparations for potato scab, it can be seen that at the beginning of the growing season, the biological efficacy of the preparations was from medium to high and amounted to 34.5 –96.3%. The highest was observed in the combined two- and three-component preparations Emesto Silver and Celest Top (88 and 96%, respectively).

4. The two preparations with the lowest lesions by the end of vegetation for potato scab stood out – Emesto Silver and Celest Top (13 and 19%).

5. The highest yield increase was obtained with two-component preparation Emesto Silver (8.3 t/ha) and three-component preparation Celest Top (9.8 c/ha).

RECOMMENDATIONS FOR PRODUCTION

To obtain high and stable potato yields and maximum protection against diseases (anthracnose, potato scab) it is necessary to use multicomponent preparations with high biological efficiency, such as Celest Top, which provides maximum yield increase.

Multicomponent preparations provide stable increase in the number of tubers on one bush and tuber weight from one bush.

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