

# Efficiency of Promising Varieties and New Fungicides against Fungal Diseases of Potato in the Southeast of Kazakhstan

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**Abstract**—In our experiments potato varieties such as Berkut, Jualy, Ushkonyr and Edem were the least infected by *Alternaria*. The degree of their severity, on average in 2014 and 2015 was 25,3 and 26,6%, respectively. Other studied varieties were greater infected: Tien-Shanski – 27,0%; Tekes – 27,6%; Udovicki – 28,0%; Nur-Alem – 28,6%; Zholbarys – 28,6 and Aksor – 31,6%.

In experiments with testing of fungicides infestation of plants on the control was 31,6%. After threefold application of the drugs the degree of infestation has been decreased up to 3,3-4,2%. All tested fungicides demonstrated high efficiency. Furthermore, the highest rate was marked in experiments with Ratamil (89,87%) and Thanos (89,55%).

**Keywords**—Potato, variety, fungicide, disease, productivity.

## I. INTRODUCTION

The potato belongs to the genus of *Solanum* L, Solanaceae family, to the section *Tuberarium* (Dick). Buk. The area of the section *Tuberarium* is America, except the tropical climate zone, and extends from the southern part of Chile and Argentina, across all countries in South and Central America to southern areas of the United States. Most of the 150 known species of potato grow in South America [1].

Potato is an important crop. As a source of protein, carbohydrates, vitamins and mineral elements, it has a high nutritional value, good taste, dietary and medicinal properties, that makes possible to use it for the production of the combined products. The advantage of these products is mutual enrichment of their constituent ingredients. According to Kazakh Academy of Nutrition, the norm of potato consumption per 1 inhabitant of the republic is 100 kg [2].

In Kazakhstan potatoes are cultivated in the area of 185-190 thousand hectares. Gross yield is 3000,0-3400,0 thousand tons per year. The average yield of tubers remains low, about 14,0-16,0 t / ha. This is due to the fact that in the hot and arid climate of most regions of Kazakhstan with a strong prevalence of severe viral, fungal and bacterial diseases, many high-yield

varieties of domestic breeding on 5-6-year, and foreign selection already on the 3-4-year of reproduction reduce productivity sharply, impair the quality indicators and keeping quality is subjected to a dramatic degeneration. It should be also noted that many varieties of potatoes cannot withstand to stressful environmental factors and cannot realize their biological potential due to the lack of agricultural technologies. In addressing this issue, the main role is given to the selection, which generates high-yield varieties resistant to biotic and abiotic factors, which do not require chemical measures to protect plants from disease. Consequently, the environment is much less polluted. Of course, the variety cannot completely exclude the use of plant protection products. However, during the cultivation of potato varieties resistant to pests and diseases, the use of chemical treatments with pesticides is reduced to a minimum.

At the present stage of potato farming development, when there are a lot of highly efficient developed and implemented technologies, as well as scientists' advanced technological developments and high-performance agricultural machinery, varieties with the best economically valuable traits go to the forefront.

The importance of varieties is particularly high in potato and vegetable production, where the potential of plants and productivity of the fields ten times more than in other sectors of agriculture. In these industries the plant diseases during the growing season and during storage are most pronounced. The acute problem is the ecological purity of the crop, high demands on the suitability of products for industrial processing and long term storage. Varieties must provide the highest yield per unit of area due to the limited irrigated land in potato and vegetable production

Among the pests of potatoes especially harmful are fungal diseases that cause enormous damage to crop yields. Along with the selection of tolerant to fungal diseases potato varieties the use of the fungicides is considered to be effective. Chemical industry around the world produces new drugs every year. It is necessary to assess their biological and economic efficiency before recommending them to the production.

Given the relevance of the above problems, the study on the evaluation of new potato varieties for resistance to diseases was conducted. Effectiveness of new fungicides against fungal diseases affecting plants during the growing season was determined.

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## II. MATERIALS AND METHODS

Research was conducted on experienced fields of Kazakh Research Institute of Potato and Vegetable Farming (KazRIPV), in the foothills of the south-east Kazakhstan in 2014-2015. Experimental fields are located on the northern slope of the Trans-Ili Alatau at an altitude of 1000-1050 meters above sea level. Soil of KazRIPV experimental plot is dark brown, medium loamy. Humus content is 2,9-3,0%, total nitrogen is 0,18-0,20%, total phosphorus is 0,19-0,20%, and exchangeable potassium is 2,3 - 2.5%. Soil is moderately provided with mobile forms of nutrients.

The bulk density of soil is 1,1-1,2 kg / sm<sup>3</sup>, and the lowest moisture content is 26,6%. Soil structure is loose, ill-defined. Swim under irrigation and the rains, forming a dense crust, which breaks its water and air regimes.

Climate of the foothill zone in the south-east of Kazakhstan (the foothills of the Trans-Ili Alatau) is sharply continental. It is distinguished by large annual and daily fluctuations in temperature; it is characterized by long hot summers and cold winters.

In the warm season the relative air humidity with an increase in temperature decreases rapidly and reaches a minimum point (35-40%) in July and August. Maximum relative humidity is during the winter period (December-February) and reaches 85-90%. In the summer months during the large amount of precipitation in some years, the relative air humidity reaches a higher value up to 65-60%. On average, the humidity in the summer ranges between 50-60%.

Due to strong insolation during the weather with clear sky and low humidity a strong warming is formed which results in forming of the dry tropical air [3].

In general, the soil and climatic conditions of a foothill zone of the south-east of Kazakhstan are favorable for potato cultivation.

The objects of our research are the culture of potato, new potato varieties of Kazakhstan selection, fungal diseases of potato and new fungicides for disease control.

In the experiments to assess the sustainability of new breeding achievements to fungal diseases of potato the following varieties were studied:

**Aksor.** Bush is upright, tall. Stems are slightly branched, poorly painted at the bottom of the stem. The leaves are light green, matt, of average size. Corolla is white, medium size. Tubers are white; round-oval to elongated, peel is rough. Eyes are medium-deep, not painted. Tubers pulp is white, smooth no darkening when cutting.

The variety is middle-ripening, cancer resistant, for multi-purpose, high-yielding, drought-resistant and has good keeping quality during storage as well as field resistance to viral diseases, macrosporiosis and *Alternaria*. It is not affected by rusty spotting of tubers, suitable for industrial processing into high-quality food.

**Berkut.** Bush is upright, tall; stems are slightly branched of average thickness. Stem is colored by anthocyanin along with the entire length, rounded cross-section. The leaves are small and green. Painting corolla is white, fine. Tubers are oblong-oval, apex is blunt, superficial eyes, smooth yellow

peel. Flesh is light yellow, no darkening after cutting in the form of raw or boiled.

The variety is middle-ripening, for multi-purpose, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality food and starch.

**Zholbarys.** Bush is middle, half upright, compact, moderately branching stems. Leaves are small, the green, glossy. Painting corolla is red-purple with white mucronate. The tubers are round-oval, moderately deep eyes, tinted in pink. The peel is from smooth to netted, yellow. The flesh is white, smooth, no darkening after cutting neither raw nor boiled.

The variety is early-ripening, for multi-purpose, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality food and starch.

**Jualy.** Bush is branchy, tall, slightly branching stems. Leafy is average. The leaves are medium, dark green, matt. Painting of corolla is white. Tubers are rounded-oval. Eyes are moderately deep, rough peel, yellow, white pulp, without darkening after cutting neither raw nor boiled for 24 hours.

The variety is medium-early, for multi-purpose, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality food and starch.

**Nur-Alem.** Bush is branchy, medium. Stems are moderately branched. Leafy is average. The leaves are green, glossy, medium size. Corolla is blue-purple. Tuber is yellow, oblong-oval, smooth peel. Tuber flesh is light yellow without darkening when cutting. Eyes are numerous, the surface is not painted.

The variety is early-ripening, for multi-purpose, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality chips and fries.

**Tekes.** Bush is branchy, medium. Stems are moderately branched. Leafy is average. The leaves are green, matt, medium size. Corolla is blue-violet. Tuber is from round-oval to oblong-oval, superficial eyes, smooth peel. Tuber flesh is light yellow without darkening when cutting.

The variety is medium-early, high-yielding, heat-resistant, drought-resistant, has field resistance to common diseases in Kazakhstan.

**Tien-Shanski.** Bush is half branchy, tall. Stems are moderately branched. Leafy is average. The leaves are green, glossy, medium size. Corolla is white. Tuber is yellow, round; peel is rough. Tuber flesh is light yellow without darkening when cutting.

The variety is medium-early, high-yielding, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality chips and starch.

**Udovicki.** Bush is upright, tall; stems are slightly branched. Leafy is average. The leaves are green, glossy, medium size. Corolla is red-purple with white mucronate. Tubers are

oblong-oval, apex is blunt, superficial eyes, smooth red peel. Tuber flesh is light yellow without darkening when cutting.

The variety is middle-late ripening, for multi-purpose, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality food and chips.

**Ushkonyr.** Bush is upright, tall, compact. Stems are green strongly branched. The leaves are dark green, medium size. Corolla is white, abundant flowering. Tuber is red, round; peel is a little flaky, white pulp.

The variety is mid, high-yielding. It is relatively resistant to late blight, drought and heat-resistant, highly resistant to viral diseases. Less sprouting during the storage

**Edem.** Bush is half branchy, middle. Stems are moderately branched. Leafy is average. The leaves are green, glossy, medium size. Corolla is white. Tuber is yellow, round-oval; peel is smooth. Tuber flesh is white without darkening when cutting. Eyes are on the surface, unpainted.

The variety is early ripening, high-yielding, high-yielding, drought-resistant and has field resistance to common diseases in Kazakhstan, suitable for industrial processing into high-quality chips and starch. .

In the experiments to assess the biological and economic effectiveness of new fungicides against the fungal diseases of potatoes the following drugs were tested: Bravo 500, suspension concentrate - 2,2 l/ha (chlorothalonil 500 g/l); Ordan, shrivel powder - 2,0 kg/ha (copper oxychloride 689 g/kg + cymoxanil 42 g/kg); Ratamil, 72% shrivel powder - 2,5 kg/ha (mankozeb (640 g/kg) and metalaxyl (80 g/kg)); Fungoceb, 80% shrivel powder - 1,2 kg/ha (Mankozeb, 800 g/kg); Thanos, 500, water-dispersible granules - 0,6 kg/ha (250 g/kg famoxadone + 250 g/kg cymoxanil); Kurzat R, 732 shrivel powder - 2,5 kg/ha (copper oxychloride + cymoxanil).

The purpose of research is to assess the sustainability of new potato varieties to fungal diseases, to identify their prevalence and infestation of plants in the southeast of Kazakhstan; to study the biological and economic efficiencies of new fungicides against diseases.

Research was conducted according to conventional methods: "Methods of field experience" [4]; "Guidelines for the registration tests of fungicides, seed veer and biologics in crop production" [5]; Agrotechnics in the experiences the generally accepted for piedmont area in south-east of Kazakhstan, that were carried out in accordance with the recommendations of the [6], [7].

When accounting *Alternaria* on potato plants, the extent of the disease defeat was determined according to the following scale:

- 0 point - no symptoms of a defeat;
- 1 point – the defeat from 1 to 10% of the leaf surface as single spots on individual potato plants;
- 2 points - the defeat from 10 to 20% of the leaf surface potato plants;
- 3 points - the defeat from 20 to 30% of the leaf surface potato plants;
- 4 points - the defeat from 30 to 50% of the leaf surface potato plants;

5 points - the defeat from 50% of the leaf surface of all plants;

6 points - all the leaves of potato plants completely affected by the disease

### III. RESULTS AND DISCUSSION

Diseases of potato occur under the influence of pathogenic organisms (infectious diseases) or adverse environmental conditions (non-communicable diseases). It causes irreversible damage in the metabolism, leading to a sharp decrease in plant productivity and to deterioration of its quality or total loss.

*Alternaria* is a disease caused by imperfect fungi (*Alternaria* or macrosporiosis). The defeat of potato during epiphytotic can reach up to 70%. The yield of tubers is reduced by 20-40% due to the withering away of the leaves during the tuber formation. *Phytophthora* is a disease of potato caused by parasitic fungi. It manifests in the phase of budding - flowering of potatoes. It affects leaves, stems, tubers, buds, berries. Loss of crop can be reached up to 30-50% [8].

*Alternaria* is most harmful (pathogen *Alternaria solani* (Ell. Et Mart.) Sor.) among fungal diseases of cormophyte biomass of potato in the south-eastern Kazakhstan. In the region *Phytophthora* is weak, but in some years there may be epiphytotic of disease.

Defeat of cormophyte biomass of potato reduces crop productivity significantly. This is due to the weakening photosynthetic activity of affected plants. Absolutely resistant potato varieties of the disease are not present. In Kazakhstan, more than 40 potato varieties of domestic breeding have been approved for use. Many of the recognized varieties of potato are relatively resistant to the most harmful diseases affecting the crop during the growing season (late blight, *Alternaria*).

The strong development of the disease does not allow new potato varieties to realize their genetic and biological potential of productivity as much as possible. Therefore, in the leading countries during the growing season of potato fungicides are used 5-7 times or even more. In Kazakhstan it is limited to 2-3 treatments or is not used at all.

For 2 years of study (Table 1) the distribution of *Alternaria* ranged from 56 to 68%. Middle-ripening variety Aksor used as standard was the most affected by *Alternaria* (68%) compared with other varieties. In medium early variety Jualy prevalence of the disease was the lowest - 56%. In varieties Berkut, Tien-Shanski, Ushkonyr, Eden, Tekes, Zholbarys, Nur-Alem and Udovicki this figure has ranged from 58% to 62%. It should be noted that during the years of studies plants affected by fungal diseases completely (6 points) during the growing season were not find. It is also noted that small number of plants (2-5%) was affected by *Alternaria* strongly (5 points). There was no disease (0 points) from 32 to 44% of the plants, depending on the varietal characteristics of culture.

The degree of the defeat of potato plants by *Alternaria* varied significantly, depending on the varietal characteristics. On average for the years of research it ranged from 25,3% (Medium-early varieties) to 31,6% (mid-season). Thus sectional plant varieties infestation differed slightly. Furthermore, in the Medium-early varieties figures were as

follows: Jualy - 25,3%, Edem - 26,3%, Tien-Shanski - 27,3%, Tekes - 27,6% and Zholbarys - 28,6%. Middle-ripening varieties had the following values of the affected plants: Berkut - 26,3%, Ushkonyr - 26,6%, Nur-Alem - 28,6% and Aksor -

31,6%. Plants of the moderately late variety Udovicki was exposed to the disease at the level of 28,0%.

TABLE I: PREVALENCE AND DEGREE OF INJURY BLIGHT ON THE PLANTING OF NEW VARIETIES OF POTATOES (2014-2015)

Varieties	Years of recognizing	Number of potato leaves, pieces	Infected, pieces							Overall score	The spread of disease, %	Sum of frequency points	The degree of infection, %
			0	1	2	3	4	5	6				
Aksor (standard)	1998	50	16	6	7	11	8	2	0	34	68	95	31,6
Berkut	2014	50	21	6	6	8	8	1	0	29	58	79	26,3
Zholbarys	2013	50	20	5	6	9	8	2	0	30	62	86	28,6
Jualy	2012	50	22	5	6	10	6	1	0	28	56	76	25,3
Nur-Alem	2013	50	19	5	8	9	7	2	0	31	62	86	28,6
Tekes	2012	50	20	6	6	9	7	2	0	30	60	83	27,6
Tien-Shanski	2014	50	21	5	7	8	7	2	0	29	58	81	27,0
Udovicki	2013	50	20	5	7	9	7	2	0	30	60	84	28,0
Ushkonyr	2012	50	21	6	6	8	7	2	0	29	58	80	26,6
Edem	2016	50	21	5	8	8	6	2	0	29	58	79	26,3

In order to control fungal diseases various fungicides were recommended. According to the test results a variety of biological and economic efficiency of fungicides against fungal diseases of potato were revealed (Table 2). Infected plants on control was 31,6%. After threefold application of the drugs the degree of damage plants decreased to 3,3-4,2%. Relatively lower biological efficiency was marked on the variant with a fungicide Bravo. The average value of the drug was amounted to 86,71% during 2 years of the research. In experiments with drugs Ordan, Kurzat P, and Fungoceb percentage of biological

efficiency was at 88% (87,34%, 87,97% and 88,29%, respectively). Higher rates were obtained on variants with new drugs and Thanos and Ratamil in comparison with the above mentioned fungicides. Thus, treatment of potato plants with drug Thanos in norm of 0,6 kg/ha and Ratamil in the norm of 2.5 kg/ha provided a positive effect of the protection against Alternaria up to 89,55% and 89,87%, respectively.

Studied fungicides differed according to the economic efficiency, in terms of productivity and the value of the stored potato crop.

TABLE II: THE BIOLOGICAL AND ECONOMIC EFFECTIVENESS OF NEW FUNGICIDES AGAINST POTATO ALTERNARIA (2014-2015)

Treatments	Infected plants by Alternaria%		Biological efficiency, %	Yields of tubers t / ha	Saved potato crop	
	before treatment	after three treatments			t / ha	%
Control (no treatment)	31,6	-	-	25,5	-	-
Bravo	-	4,2	86,71	31,4	5,9	23,14
Ordan	-	4,0	87,34	31,8	6,3	24,71
Ratamil	-	3,5	89,87	34,1	8,6	33,73
Fungoceb	-	3,7	88,29	33,0	7,5	29,41
Thanos	-	3,3	89,55	33,7	8,2	32,16
Kurzat R	-	3,8	87,97	32,5	7,0	25,49

The economic efficiency of fungicides Ordan Kurzat R and Fungoceb was higher. Treatment of potato plants against Alternaria in the growing season with these fungicides have ensured the preservation of 6,3, 7,0 and 7,5 t/ha of crop, which is 24,71%, 25,49% and 29,41% to the untreated control. Application of fungicides Thanos and Ratamil have led to the increase in the potato yield up to 8,2-8,6 t/ha compared to the control and the value of the stored harvest was 32,16% and 33,76%, respectively.

#### IV. CONCLUSION

Thus, according to the results of our studies new varieties such as Berkut, Jualy, Ushkonyr and Edem were the most resistant to Alternaria. All studied new fungicides have had highly effective activity against fungal diseases (Alternaria). During the treatment against Alternaria fungicides Ratamil (89,87%) and Thanos (89,55%) were the most

efficient. Tuber yield without diseases was amounted up to 23,14-33,73%.

#### REFERENCES

- [1] Bukasov S.M., Kameraz A.Y. Selection and seed farming of potatoes - L.: "Kolos", 1972. - pp. 7-9.
- [2] <http://zdravclub.ru/stati/412-normy-potrebleniya-ovoshhej-na-odnogo-cheloveka.html>
- [3] M. Rubenstein Brief description of the natural and economic conditions / recommendations system in Agriculture (Almaty region) // Alma-Ata "Kaynar". -1978. - pp. 6-11.
- [4] Dosphehov B.A. Methods of field experience. - M.: "Kolos", 1985 - pp. 420.
- [5] The cultivation of Kazakhstan selection potato varieties, seed veer and biologics in crop production - Almaty - Akmola, 1997. - pp. 64.
- [6] Recommendations for the spring sowing campaign in the south-east of Kazakhstan. - Almaty, 2004. - pp. 32.
- [7] The cultivation of Kazakhstan selection potato varieties / recommendation. - KazSRIPV. - Almaty, 2012. - pp. 36.
- [8] Zolfagari A. Phytophthora and potato Alternaria and tomato in the abnormal weather conditions in the Moscow region / J. Plant Protection and Quarantine. - №12. - 2011. - pp. 40-42.