Development of diseases early potatoes in the cultivation of two harvests in the conditions of the Moscow region

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Abstract. Potatoes are an important crop for the country's food security. In connection with the warming of the climate, it becomes possible to cultivate two crops of potatoes in one growing season. Potatoes can be affected by numerous diseases, the most dangerous in our zone are Phytophthora infestans and, in recent years, Alternaria. According to various sources, losses amount to 50%. The use of resistant varieties reduces the pesticide load on the crop agrocenosis. The article presents the results of studies of field resistance of different varieties of potatoes to Alternaria and Phytophthora infestans, as well as the use of effective fungicides of systemic action. It was revealed that during the cultivation of two early harvests of potatoes during one growing season, differentiation of diseases occurs in the summer: Alternaria develops during the first planting, and Phytophthora infestans during the second planting. For the first planting, it is necessary to use varieties resistant to Alternaria (Zhukovsky, Lady Claire, Red Scarlet and Impala), for the second planting, resistant to Phytophthora infestans (Luck). In the system of protective measures, it is necessary to include one treatment with systemic fungicides, it is necessary to take into account the waiting period, as the growing season is short.

1. Introduction

Potatoes are an extremely important crop for our country, as they can be used for a wide variety of economic purposes: for feeding the population. Potatoes is one of the insurance crops [1]. Over a billion people worldwide consume potato tubers [2]. This is due to the fact that, in terms of the amount of digestible protein, 1 ha of potatoes gives more than 1 ha of corn, fodder beets, rye, barley and other crops [3]. This culture plays a huge role in ensuring the country's food security. Potato production in the world is growing [1 and 4], Russia remains the largest potato producer. For further production growth, it is necessary to increase not only the yield of this valuable crop, but also its quality. To increase production volumes and improve product quality, it is necessary to increase crop yields by cultivating two crops in one growing season [1], as well as reduce losses from the development and spread of diseases [5].

The potato is prone to numerous diseases. Phytophthora infestans is the most common in the Moscow region, and alternariosis also spread in recent years [5-6]. In our country, up to 4 million tons of potatoes are lost annually from Phytophthora infestans. At the same time, in the years of epiphytoties, in the absence of timely protection, the productivity of varieties susceptible to the disease decreases by 1.5-2 times [7-8]. There have always been problems with Phytophthora infestans, but in recent years the situation has become more complicated due to the fact that two types of it (A1 and A2) form new sexual combinations, adapt quickly, the latency period decreases and the resistance
genes of potato plants are overcome [5-8]. Due to the change in the population of the fungus, there is a decrease in sensitivity to fungicides.

Currently, one of the dangerous diseases of potatoes during the growing season is Alternaria. In recent years, this disease has become widespread in the middle of Russia [8]. The disease is caused by fungi of the genus Alternaria. The characteristic symptoms are the formation of numerous dry black or dark brown spots on the leaf blades of potatoes (Fig. 1). The infection persists in the soil, on plant debris and in seed tubers [9]. Under favorable conditions, the development of this pathogen can significantly reduce the potato yield. The most harmful is Alternaria with an early appearance and a high rate of development during the growing season [10].

Biologization of plant protection provides for a significant reduction in the use of pesticides in agroecoses of agricultural crops. In this case, such methods of protection as the cultivation of resistant varieties and the improvement of existing methods of using pesticides through the use of new environmentally safer groups of drugs are of great importance [11]. Previous studies have shown the decisive role of potato varietal resistance in planning protective measures against Phytophthora infestans and Alternaria [12].

The purpose of our research was to study the field resistance of different varieties of early potatoes to Alternaria and Phytophthora infestans to obtain high-quality products.

2. Materials and methods

Studies were carried out in 2019 - 2020 years on the site of the laboratory of vegetable growing RGAU-MSHA named after K.A. Timiryazev. Soils are soddy-podzolic medium loamy. Standing density of 46.7 thousand plants per hectare. For planting used tubers of the middle fraction (40 - 80 g), large fraction (more than 80 g), the elite. The cultivated varieties were: Luck, Zhukovsky early, Meteor, Red Scarlet, Lady Claire, Impala, Golubizna. Planting dates: first: - when the soil warms up to 6 - 8 °C, the second - in the middle of July. Options for the first crop: 1) middle fraction without germination, 2) middle fraction with germination; 3) coarse fraction with germination. The second planting was carried out immediately after the harvesting of the first planting in the vacant place with planting material of the year of the same varieties, all planting material of the past was germinated. Planting options for the second harvest: 1) control; 2) + glauconite sands 30 g/bush; 3) + glauconite sands 20 g/bush. The cultivation technology is standard. Planting was carried out with a single-row potato planter for field research. Harvesting was carried out using the method of research on potato culture [13]. Cleaning took place on July 15th and September 20.

3. Results and Discussion

In recent years, the climate has been warming [14]; the sum of active temperatures [2 and 15] and the duration of the growing season are increasing, which makes it possible to cultivate potatoes early two times during the growing season. In connection with warming, there are changes in the spread and development of plant diseases. Today, it is known that early potato varieties do not have a sufficient level of resistance to pathogens, which leads to their even greater spread and accumulation. In the characteristics of early potato varieties, information is given on their resistance or susceptibility to Phytophthora infestans, while there is no such information on Alternaria. It is also important to note that there are no varieties with absolute resistance to Phytophthora infestans. However, there are varieties that are less affected by the disease, such as: Nevsky, Zarya, Golubizna, etc.

Agroclimatic conditions of the growing seasons of 2019-2020, namely high temperatures and abundant rainfall, were favorable for the development of Alternaria on early potatoes. The research was carried out on 6 varieties: Luck, Zhukovsky, Meteor, Lady Claire, Red Scarlet, Golubizna. It is known that early potato varieties do not have a sufficient level of resistance, which leads to an even greater spread and accumulation of pathogens. In the characteristics of early potato varieties, information is given on their resistance or susceptibility to Phytophthora infestans, while there is no such information on Alternaria.
Surveys of early potato plantings were carried out in the third decade of June according to generally accepted methods. Leaf infection with Alternariawas assessed using a 6-point scale [16]. The following indicators were calculated: development (R),%; prevalence (P),%; biological efficiency (C),%.

The development and prevalence of the disease, % on different varieties of early potatoes, before processing is shown in (figure 2).

Two-year observations showed that the greatest development of Alternariawas noted on the varieties Golubizna, Meteor (figure 2). The plants of the varieties Zhukovsky, Lady Claire and Impala were affected to a lesser extent. The prevalence of Alternaria in 2020 exceeded 50% in all studied variants, while in 2019 it was much lower in Zhukovsky and Lady Claire varieties.

To stop the development and spread of infection, we carried out a single treatment of potato plantings with the drug Luna Tranquility, KS (fluopyram 125 g/l and pyrimethanil 375 g/l) in all years. The fungicide application rate is 0.8 l/ha.

The development and distribution of Alternaria on various varieties of early potatoes, after processing, is shown in (figure 3).

Spraying early potato plantings with a fungicide (figure 3) contributed reduce the development of the disease, however, in the varieties Luck, Meteor and Golubizna it was the best in all periods of research. The highest prevalence of Alternariawas noted during the growing season of 2020. In options: Luck, Meteor, Blueness, the spread reached 100%.

The biological effectiveness of the fungicide Luna Tranquility, KS was carried out according to the modified Abbot formula. In the growing season 2019-20, it was at the level of 50%, in 2020 it was 65%.
Thus, in the conditions of the growing seasons 2018-2020. The studies carried out revealed potato varieties susceptible to Alternaria: Meteor, Golubizna, Luck. For further resistance to Alternaria, the following varieties can be recommended: Zhukovsky, Lady Claire, Red Scarlet and Impala. To reduce and spread the causative agent of Alternaria on early potatoes, at the first sign, we recommend to carry out a single treatment of the plantings with a fungicide. At the same time, it is necessary to ensure such important indicators as weather conditions and the waiting time for the drug.

On potato plants of early harvest, the development and spread of Phytophthora infestans was not observed. Phytophthora infestans was noted during the cultivation of the second crop; Alternaria was not observed during the second planting. Agroclimatic conditions during the period were favorable for the development and spread of the pathogen. Research was carried out on five varieties: Meteor, Lady Claire, Zhukovsky, Red Scarlet, Luck. The development and spread of the disease was determined. The development of Phytophthora infestans on potato leaves and shoots is shown in (figure 4).

The development of Phytophthora infestans on early potato varieties of the second planting date showed 100% damage to the aerial parts of plants of the Lady Claire variety. On varieties: Meteor, Zhukovsky and Red Scarlet, the development was 4.6%; 6.3% and 4.0%, respectively. Variety Luck was less affected by Phytophthora infestans, the development of which was at the level of 1.4%. The spread of the disease in potato plantings was at the level of 100% for all varieties of the experiment.
4. Conclusion
Based on the above:

- When cultivating potatoes of two early harvests in one growing season, differentiation of diseases occurs in the summer period: Alternaria develops at the first planting, at the second planting Phytophthora infestans develops;
- For the first planting, it is necessary to use varieties resistant to Alternaria (Zhukovsky, Lady Claire, Red Scarlet and Impala), for the second planting, resistant to Phytophthora infestans (Luck);
- In the system of protective measures, it is necessary to include one treatment with systemic fungicides, it is necessary to take into account the waiting period, since the growing season is short.

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