Dynamics of the number of aphids - vectors of viruses in the vertical zoning of the North Caucasus

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Abstract. Viral diseases are recognized as the most dangerous potato diseases due to the fact that their development can bring significant economic losses. Viruses infecting potatoes carry a significant number of vectors. Aphids are carriers of viral diseases. The results of studying aphidoфаuna showed that the most important carriers of potato viruses in the North Caucasus are aphids - peach, leguminous, large potato, common potato.

1. Introduction

The cultivation of potatoes, one of the main food crops, has reached a significant level throughout the world. In the current economic conditions, many potato growers strive not only to increase yields, but also to improve the quality of the resulting crop. For these purposes, in the practice of sustainable agricultural development, many states have adopted a number of long-term programs to improve the phytosanitary state of potatoes, and, as a consequence, to improve the marketability of the potato crop [1].

Currently, about two dozen viruses have been identified that infect potatoes. Viral diseases can be spread by contact, soil fungi and free-living nematodes, but the transfer of most harmful viruses in potatoes occurs with the help of aphids, cicadas, bedbugs [2,3].

In the field, most of the harmful viruses in potatoes are transported mainly by insect vectors - aphids. They are usually the main focus of studying the summer dynamics of virus carriers. The most important criteria characterizing aphids in the transfer of potato viruses during the growing season is paid special attention to the dynamics of summer on potato plantings.

Aphids are highly specialized phytophages. The main habitat of aphids is herbaceous plants. Their numerous colonies can be found on roadside strips and trails of forest strips [4].

The results of many years of experiments have proven that in the mountainous zone of the Republic of North Ossetia, at an altitude of 1650 meters above sea level and above, there are no aphids - carriers of viruses, therefore, mountainous regions of the republic of this height are a natural isolator from viral infection. In the foothill zone, the most numerous representatives of aphids - carriers are peach, buckthorn, buckthorn, the number of which per standard trap varies from year to year [5,6,7].

In the foothill zone, they go through a full life cycle. The migration of cicadas and bedbugs is intensified in hot dry years, they move to agricultural crops from perennial grasses and weeds.
On potato plants, they spread pathologies of viral (SBK, MBK, XBK, LBK), phytoplasmic and viroid origin. When determining the "critical threshold", their number is not taken into account, since the harmfulness of bugs and cicadas does not exceed the permissible norm. The filamentous sprouts of potato tubers are a consequence of the defeat of the potato by cicadas. According to a number of authors, in the conditions of the foothill zone of the North Caucasus, the number of virus carriers depends to a greater extent on meteorological conditions and to a lesser extent on the presence of entomophages, since they appear later than the intensive flight of aphids and cicadas [8, 9].

2. Method of the research
To observe the dynamics of aphids, the yellow Merike traps were used. Place the yellow cups directly on the soil surface; on a 5x5 m area of clean steam, at the edge of a potato field. Water is poured into the cups, just above the edge of the yellow paint. Aphids are sampled daily from yellow cups by filtering through a gauze napkin. Then the gauze with the remaining insects on it is put into a bottle with 80% alcohol. In the laboratory, gauze napkins are unrolled on watch glasses. Aphids are counted and identified under a binocular loupe. Alcohol samples can be preserved for several months. Once a decade, from the moment of emergence and until the tops dried, wingless aphids were counted by counting on 100 leaves. Leaves of the lower, middle, and upper layers were taken for counting. Leaves were collected in polyethylene bags in the morning, and aphids were counted on the same day [10,11,12].

3. Result of the research
Observations found that potato plants damaged all common types of aphid vectors: large potato (Macrosiphum solanifolii Asha), common potato (Aulacorthu soiani Kalt), peach aphid (Myzus Sicae Suiz.) and legume aphid (Aphis fabae Scop).

The study of the dynamics of flight of aphids on potatoes was carried out on the experimental fields of the North Caucasian Research Institute of Mining and Piedmont Agriculture - a branch of the Federal State Budgetary Institution of Science of the Federal Scientific Center "Vladikavkaz Scientific Center of the Russian Academy of Sciences" (NCRIMPA - a branch of the FSBIS of the FSC “VSC of the RAS”) over the past six years. In 2017-2019 investigations were continued to determine the dynamics of the number of vector aphids depending on the distribution zone, stages of organogenesis of the host plant and the effect of weather conditions on them.

The most harmful and widespread species of aphids are of practical importance, as a result of which it is necessary to keep records and identify them. According to the main method for determining the summer of aphids, monitoring was carried out from the end of May to the end of the growing season of potatoes. The temperature regime has a significant impact on the migration of aphids. At temperatures below 13 °C and more than 30 °C, aphids are negligible for years. The most intense years of aphids are observed at an average temperature of 20-25 °C. The most suitable climate for these pests is humid (70%) and warm. During the observation period, the average monthly temperature was 18-22, with an average humidity of 75-80%. In the summer, the air temperature reached 38 °C, and therefore the air humidity fluctuated in the morning from 73% to 45% in the daytime.

In summer, the most vigorous flight of aphids was observed in the morning hours. From June 20 to July 10, the economic threshold of harmfulness was exceeded by the number of the most dangerous individuals. Average number of aphids on potatoes in 2013-2016 amounted to 389 individuals per trap per decade.

In agroclimatic conditions 2017-2019 in the foothill zone of North Ossetia, the beginning of the summer of aphids was noted in the second decade of May. The total number of aphids per trap in 2017 was 491 individuals. The most numerous in the catches of this year was the common potato aphid, on average 147 specimens per trap, and 116 specimens of the peach aphid species. The mass years of buckthorn and buckthorn aphids were recorded in the second decade of July with an average number of 80-90 individuals.
In 2018, only 70 mm of precipitation fell during the potato growing season. The relative humidity in the morning hours was 45–50%, in the daytime it was 25–39%. The lack of sufficient humidity in the atmosphere affected the biology and distribution of phyto-fauna. The number of aphids caught per trap per decade was minimal - 52 specimens. The average number of aphids in 2018 was 267 individuals, of which: - common aphid - 105 individuals, peach - 56, buckthorn and buckthorn aphids - 106 individuals.

Due to the meteorological conditions in 2019, wingless aphids were not found. The observed low abundance of aphids in these years was due, as mentioned above, to weather conditions in late May and early June, which held back the winged individuals and their colonization of potato plants. In the second decade of August, single specimens of wingless aphids were recorded. The maximum number of wingless aphids on 100 leaves is observed on potato plants and averaged 28 individuals.

The next two years of research showed that the flight period of aphids begins in the second - third decades of May and lasts until the third decade of August. The beginning of mass flight is strongly influenced by the intensity with which the sum of positive temperatures accumulates in the spring. The earlier this happens, the earlier the period of dispersal of winged aphids from the primary host begins.

Only the rains characteristic of this period are capable of halting the second peak of summer of aphids, which begins in North Ossetia in autumn. According to the results of long-term observations since 2013, the number of aphids in September – October does not exceed 62 individuals. into the trap. The exception was 2015-2016, when daytime air temperatures favored their summer, and there was no precipitation for this period. The meteorological conditions in the second half of the summer of 2015 contributed to a twofold increase in the number of virus carriers. Based on this, an increase in their migration was predicted during the spring summer in 2016. However, consistently low temperatures in December – January (minus 5 ° C) caused a decrease in the number of overwintered individuals and, accordingly, a decrease in their number in the growing season of 2017.

4. Conclusion

1. In the mountainous zone of the Republic of North Ossetia-Alania, at an altitude of 1650 meters above sea level and above, there are practically no aphids - carriers of viruses, therefore the mountainous regions of the republic of this height are a natural isolator from viral infection.

2. In the foothill zone of the Republic of North Ossetia, the most numerous representatives of aphids - vectors are beet, buckthorn, buckthorn, common aphids, the number of which per standard trap varies from 35 to 491 per year. on a cup of Merike.

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