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4.1.1 Общее земледелие, растениеводство (биологические науки, сельскохозяйственные науки)

КОРРЕЛЯЦИОННО-РЕГРЕССИОННЫЙ АНАЛИЗ ЗАВИСИМОСТИ УРОЖАЙНОСТИ ОТ СОДЕРЖАНИЯ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ В ПОЧВЕ В СЕВООБОРОТЕ С ПРОПАШНЫМИ КУЛЬТУРАМИ В АРИДНОЙ ЗОНЕ НИЖНЕГО ПОВОЛЖЬЯ

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4.1.1 General agriculture, plant growing (Biological sciences)

CORRELATION-REGRESSIVE ANALYSIS OF THE DEPENDENCE OF PRODUCTIVITY ON THE CONTENT OF NUTRIENTS IN THE SOIL IN CROP ROTATION WITH ROW CROPS IN THE ARID ZONE OF THE LOWER VOLGA REGION

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В статье рассматривается изменение урожайности картофеля в зависимости от содержания основных питательных веществ в пахотном слое почвы в условиях аридной зоны. В настоящее время в Астраханской области в структуре посевных площадей превалируют посадки картофеля и томатов. Игнорирование принципов зонального районирования сельскохозяйственных культур привело к ухудшению почвенного плодородия и выбытию значительных площадей пашни из сельскохозяйственного оборота. Использование залежи в качестве средства для отдыха почв не решает ситуацию с деградацией почвенного плодородия. А повторные посадки пропашных культур приводят к резкому снижению урожайности. Вместе с тем основными производителями картофеля и томатов в регионе выступают крестьянско-фермерские хозяйства и крупное предприятие по производству томатной пасты на Юге России ООО «АПК Астраханский», основной целью которых является выращивание наиболее рентабельных культур и гарантированное получение прибыли. К(Ф)Х Астраханской области привязаны к конкретной земельной территории и вынуждены в последние годы осваивать коротко- и среднеротационные севообороты с пропашными культурами на основе многолетних бобовых трав. ООО «АПК Астраханский» осваивает севообороты, а также новые земельные площади в Харабалинском и Красноярском районе региона

Ключевые слова: КОРРЕЛЯЦИОННО-РЕГРЕССИОННЫЙ АНАЛИЗ, УРОЖАЙНОСТЬ, МОНОКУЛЬТУРА, АРИДНАЯ ЗОНА

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The article discusses changes in potato yields depending on the content of essential nutrients in the arable soil layer in arid zones. Currently, potato and tomato plantings prevail in the structure of southern areas in the Astrakhan Region. Ignoring the principles of zonal zoning of agricultural crops has led to deterioration of soil fertility and the withdrawal of significant areas of arable land from agricultural use. Using fallow land as a means of soil rest does not solve the situation with soil fertility degradation. And repeated plantings of row crops lead to a sharp decrease in yields. At the same time, the main producers of potatoes and tomatoes in the region are peasant farms and a large enterprise for the production of tomato paste in the South of Russia, OOO APK Astrakhansky, whose main goal is to grow the most profitable crops and guarantee profit. Peasant (farm) farms of the Astrakhan region are tied to a specific land area and have been forced in recent years to develop short- and medium-rotation crop rotations with row crops based on perennial legumes. APK Astrakhansky LLC is developing crop rotations, as well as new land areas in the Kharabalinsky and Krasnoyarsk districts of the region

Keywords: CORRELATION-REGRESSIVE ANALYSIS, PRODUCTIVITY, MONO-CULTURE, ARID ZONE

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CONTENT.

1. INTRODUCTION. Currently, in the Astrakhan region, the trends of negative humus balance and desertification are becoming uncontrollable [8].

Agricultural production in the region involves 11 rural districts. However, the specialization of farms of all types of ownership does not take into account the soil and climatic conditions of the Astrakhan region. In pursuit of profit, most farms are primarily engaged in the production of the most profitable crops, such as vegetables and potatoes [3]. In some areas, a monoculture of tomatoes and potatoes is widespread, which became possible due to increased doses of mineral fertilizers, the cultivation of imported varieties and hybrids that are distinguished by the manifestation of the heterosis effect in the first year of use, good transportability and shelf life, resistance to diseases and pests [1, 4, 5, 6, 7]. However, subsequent plantings of potatoes and tomatoes lead not only to a decrease in yield, but also to the accumulation of specific harmful objects, the development of erosion processes and the manifestation of trends in the negative humus balance.

During the years of transition to market relations with the collapse of many collective and state farms, the two main branches of agriculture, crop production and livestock farming, underwent significant changes. In the structure of commercial products, the share of crop production increased, while the share of livestock farming gradually decreased. Peasant farms and large agricultural enterprises became leaders in the production of crop products, and in the production of meat and milk, private subsidiary farms of the population took first place.

In crop production, the focus on increasing the production volumes of tomatoes and potatoes, and in livestock farming, on the development of sheep farming, has identified a number of environmental problems associated with disruptions in the stability of agricultural landscapes, loss of arable land, trampling of pastures and other negative consequences.

Many farms, when using mono-plantings, have come to the need to use fallow land for two years after three years of growing potatoes and tomatoes. However, this measure does not solve the problem of soil fertility and has a negative impact on crop

yields.

2. METHOD. The research included an analysis of the dynamics of potato yields during repeated plantings in the Kharabalinsky District of the Astrakhan Region. The experiments were conducted from 2008 to 2022 according to the experimental methodology of B.A. Dospekhov [2].

When analyzing soil samples, the Machigin method was used in the modification of the Central Institute of Atomic Energy to determine the content of mobile forms of phosphorus and potassium in accordance with GOST 26205-91.

The density of plants in the phase of full shoots and before harvesting, the structure of the crop were determined according to the method of the State Variety Testing of Agricultural Crops. The crop was recorded by the weight method on a plot-by-plot basis. Mathematical processing of the results was carried out by the method of dispersion, correlation and regression analysis on a PC using the application software packages for statistical processing "Statgrafics" and "Statistica". Potatoes were grown according to the agricultural technology recommended for the Astrakhan Region.

3. RESULTS. The territory of the experimental trials is represented by gray-brown semi-desert soils. According to the granulometric composition, the soil is predominantly light loam. The humus content in the arable layer of 0–20 cm is less than 1%. The relief of the experimental site is leveled.

The analysis showed that during the years of the research, the weather conditions in the Kharabalinsky district of the Astrakhan region underwent significant changes. The analysis of average daily air temperatures shows that in March 2012 and 2018 it was below the average long-term values and amounted to minus 1.7 C and minus 1.4 C, respectively. Only 3 years were characterized by an average daily air temperature in March above 5 C (2008, 2016 and 2020). In 2012, the average daily temperature in March was the minimum of all the years under consideration, and already in April 2012 it reached 16.5 C and

turned out to be the maximum compared to the average daily air temperature in the second month of spring in other years.

The maximum values of average daily temperatures in May were recorded in 2012, 2013 and 2014: 22.1 C, 22 C and 22.4 C, respectively, the minimum in 2022 was 15.7 C.

The maximum values of average daily temperatures in June exceeded 26 C in 2010, 2019 and 2020. The minimum value of 21.8 C was recorded in 2017.

In July 2010 and 2011, average daily air temperatures reached maximum values of 29 C, and minimum values were recorded in 2013 and 2022: 24.6 C and 24.1 C, respectively.

In August 2016, 2021 and 2022, the maximum values of average daily air temperature (28 C) were observed, the minimum value (21.1 C) was recorded in 2009.

The maximum average daily temperature in September was recorded in 2015 (21 C), the minimum in 2021 (15.6 C). The maximum average daily temperature in October was recorded in 2009 (12.4 C), the minimum in 2014 (6.2 C).

Analysis of relative humidity data showed that it had maximum values in all years of research in March, and minimum values in June.

The maximum amount of precipitation fell from March to October in 2021 and 2022: 219.8 and 369 mm, respectively, and exceeded the long-term average by 32 and 121%, respectively. The fifteen-year study period for the amount of precipitation from March to October can be divided into years with sufficient, insufficient, and extremely insufficient moisture. Analysis of weather data showed that from 2008 to 2022, seven out of fifteen years were with insufficient moisture (2009, 2011, 2012, 2014, 2015, 2018, 2019). The amount of precipitation over these years varied in the range from 132.6 to 161 mm and amounted to 80...97% of the long-term average. Three years out of fifteen were extremely dry (2013, 2017 and 2020). The amount of precipitation during the

warm period fluctuated from 45.5 to 73.7 mm, or 28...45% of the long-term average. In all other years of research, the amount of precipitation for the period March-October was equal to or exceeded the long-term average. Analyzing the amount of precipitation for the period from 2008 to 2022, it can be noted that ten years out of fifteen agricultural crops in the Kharabalinsky district of the Astrakhan region experienced a lack of moisture to one degree or another, which to a certain extent affected their yield. On average, 153 mm of precipitation fell annually from 2008 to 2022, or 92% of the long-term average (Figure 1).

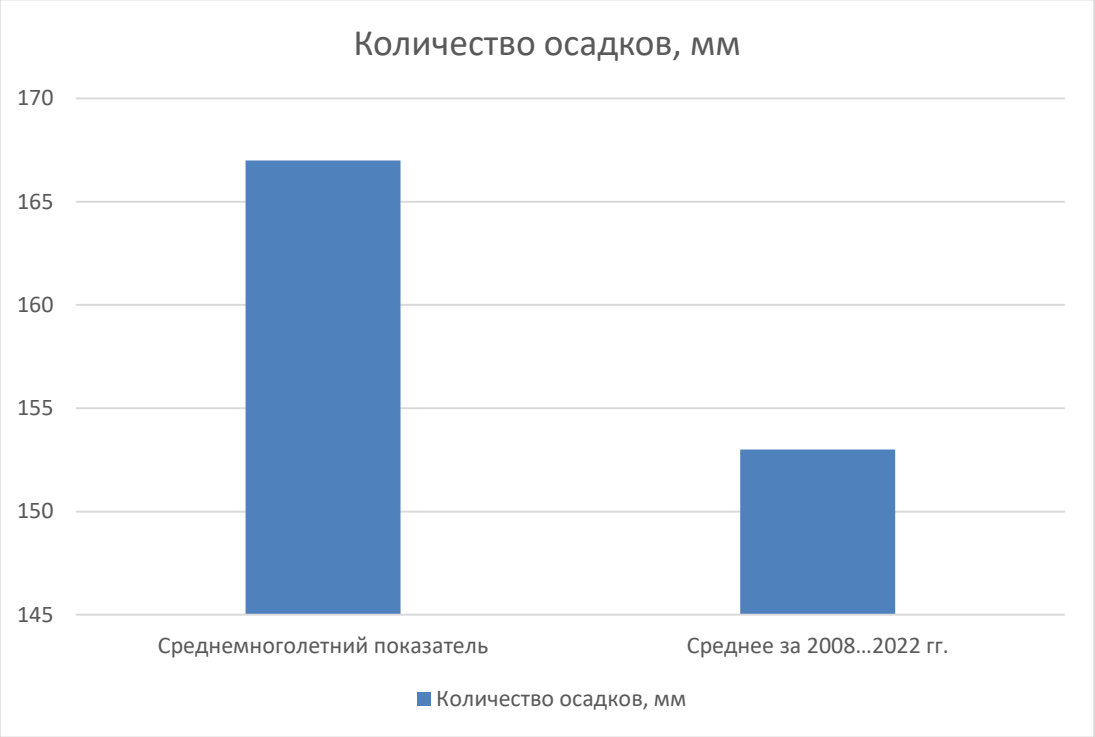

Figure 1 - Average annual precipitation (period 2008…2022)

The nature of the change in air temperature by months of the vegetation periods was inversely proportional to the amount of precipitation, i.e. with an increase in the amount of precipitation, the average monthly temperature was, as a rule, lower and vice versa. At the same time, irrigation to a certain extent leveled out the negative impact of the lack of moisture.

Based on the results of the 15-year study, the yield assessment presented in Table 1 was made.

Table 1 - Total output of products from 1 ha (t)
(Kharabalinsky district)

Option	Average yield, t/ha (2008…2022)
Crop rotation 1 field of potatoes, 2 field potatoes 3 field potatoes 4-5 field fallow land	 27 24 21

Analysis of Table 1 demonstrated an annual decrease in potato yield by 10...12% with its monoculture. The maximum level of productivity of the first potato field (30 t/ha) was obtained during the implementation of the second crop rotation, which is due to more favorable weather conditions in this period.

Correlation-regression analysis of the dependence of crop yield on the amount of easily hydrolyzed nitrogen in the soil showed that the correlation coefficient (r) is 0.982. The relationship between the studied features is direct, the tightness (strength) of the relationship according to the Chaddock scale is very high. The equation of paired linear regression is: y = 23.66667 + 1.00000 * x. The determination coefficient r2 is 0.964.

Table 2 – Changes in soil characteristics in the Kharabalinsky district of the Astrakhan region, 2008…2022.

Crop rotation	Hydrolyzable nitrogen, mg/kg	Mobile phosphorus, mg/kg	Exchangeable potassium, mg/kg
Before the implementation of crop rotation	51	50	260
After implementing three crop rotations	45	47	240

A similar trend was observed between crop yield and the content of mobile phosphorus and exchangeable potassium in the arable soil layer.

4. CONCLUSIONS, LIMITATIONS AND PROSPECTS. A close direct

connection between the content of nutrients in the soil and potato yield has been established. An annual decrease in the yield of the studied crop by 10...12% has been recorded with its mono-planting.

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