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RESEARCH ARTICLE

Influence of Air Temperature Changes and Productivity Elements at Different Observation Periods

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ABSTRACT

This article discusses and analyzes data on air temperature in the northern, southern, central and Fergana Valley regions of Uzbekistan in various periods of observation. The influence of the duration of the development phase on the height of plants, the influence of air temperature in various periods on the formation of buds was assessed. It has been established that the air temperature in the evenings has a good effect on the formation of cocoons. At the same time, proposals and recommendations are given for the development of research in the relevant areas of the industry.

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Introduction

Naturally, the consumption of agricultural products by the world's population depends on their specific national customs (traditions), origin and climatic conditions. The majority of the world's population consumes products made mainly from cereals (leaders: wheat, rice, rye and oats), including the population of Uzbekistan. Our country is also the largest producer of cotton in the Central Asian region, the sixth largest producer of cotton fiber in the world and the second largest exporter.

The elements of plant productivity, the formation of yield depends on many factors: the weather during the growing season, soil and climatic conditions, the characteristics of the breeding variety, the method and duration of planting, the location and thickness of plants, agronomic measures, etc.

Given the length of the growing season, the effect of temperature on the growth, development and future yield of plants varies. It is practically important to study the effect of temperature on the formation of productivity elements and find indicators used in forecasting. Abroad in this regard [Dana Magdalena Mic et al. 2021, Yilmaz Akdi & Kamil Demirberk Celebrity. 2021, Victor Ongoma et all, 2021, Avraham I. Kudish & Efim G. Evseev.2021, XiaopeiTang & Haijun Liu.2021,] and a number of research works in Uzbekistan and their results [Abdullaev A.K. et al 2005, Muminov F.A., Abdullaev X.M. 1997, Kholbaev G. Kh. and others. 2020]. In these studies, average air temperature was used as the meteorological magnitude as the main effect on plant productivity elements. Naturally, no research has been conducted on which observation period has the most positive effect of air temperature on plant productivity elements.

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It is known that in accordance with the recommendations of the World Meteorological Organization (WMO), meteorological observations are carried out at 00^{00}, 03^{00}, 06^{00}, 09^{00}, 12^{00}, 15^{00}, 18^{00}, 21^{00} hours on average Greenwich Mean Time. In Uzbekistan, these times are 05^{00}, 08^{00}, 11^{00}, 14^{00}, 17^{00}, 20^{00}, 23^{00}, 02^{00}.

The purpose of the study is to assess the effect of temperature on the elements of plant productivity based on observational data from stations located in the northern, central, southern and Fergana valleys of the republic.

Object and Methods of Research

In the course of the research, the data on air temperature observed at Khiva, Shakhrisabz, Bukhara, Dahbet, Yangiyul, Fergana agrometeorological stations for different periods of 2009-2019 were used. In the research process in the sources [Abdullaev A.K. and b. 2009, Ulanova E.S. and b. 1968, WMO. 2017] and the relevant standard applications used in modern computer technology in their processing.

Research Results and their Discussion

It is known that the territory of the Republic of Uzbekistan consists of plains, deserts, foothills and mountains. Thus, the territory of the republic is diverse, and the leading crops are cotton and winter wheat. We will focus on the issue of dependence of agro-climatic conditions on soil and agro-climatic conditions, soil composition and its moisture level, etc., as well as some ideas and comments on the solution of the problem of "weather and agrotechnics" in the future. Agrometeorological indicators are a quantitative expression of the relationship between plant growth, development and productivity characteristics and weather magnitudes and climatic factors.

Based on the above considerations, first of all, in order to provide hydrometeorological information to the agricultural sector in the Republic, stations located in different regions (Khiva, Shakhrisabz, Bukhara, Dahbet, Yangiyul, Fergana) at night, five and ten ((02^{00}, 05^{00}, 20^{00}, 23^{00} hours)) and average values of air temperature during daytime (8^{00}, 11^{00}, 14^{00}, 17^{00} hours) observation periods were calculated (Tables 1-2).

Table 1. The amount of air temperature for five days during the growing season (2009-2019)

Months	Five days	Agrometeorological stations											
		Khiva		Shakhrisabz		Bukhara		Dahbet		Yangiyul		Fergana	
		Tracking times, hours											
		night	daytime	night	daytime	night	daytime	night	daytime	night	daytime	night	daytime
		2-5-20-23	8-11-14-17	2-5-20-23	8-11-14-17	2-5-20-23	8-11-14-17	2-5-20-23	8-11-14-17	2-5-20-23	8-11-14-17	2-5-20-23	8-11-14-17
		Air temperature, °C											
March	1	5,1	7,7	7,9	11,8	6,1	9,4	6,4	9,9	7,8	5,8	6,1	9,8
	2	5,0	7,2	7,5	11,1	6,0	8,5	6,2	9,2	7,3	5,2	6,6	10,2
	3	6,8	9,3	8,4	12,7	7,3	10,6	6,8	10,3	8,7	6,0	7,5	11,4
	4	7,8	9,9	9,2	13,1	7,6	10,3	7,5	11,0	8,7	6,2	8,3	11,9
	5	9,3	11,6	10,4	14,6	8,9	12,1	9,2	13,1	9,9	7,3	9,8	13,9
	6	10,7	12,6	12,3	16,6	9,7	13,5	10,5	14,4	11,0	8,1	11,5	15,8
Average		7,5	9,7	9,3	13,3	7,6	10,7	7,8	11,3	8,9	6,4	8,3	12,2
April	1	10,1	12,9	11,0	15,3	9,2	12,8	9,4	13,1	10,4	7,5	11,6	16,0
	2	13,2	17,2	12,6	18,0	11,8	16,4	11,3	16,0	12,9	9,2	12,6	17,8
	3	15,4	18,2	14,7	19,8	13,2	17,5	13,3	17,8	13,9	10,0	14,7	19,9
	4	14,5	18,2	13,8	19,2	13,0	18,1	12,4	17,5	13,9	10,0	14,2	19,7
	5	16,7	19,4	15,0	21,1	15,7	20,8	14,9	20,8	15,9	11,7	16,0	22,1
	6	15,4	19,2	15,0	20,5	14,4	19,2	14,1	19,3	14,9	10,9	15,3	20,8
Average		14,2	17,5	13,7	19,0	12,9	17,5	12,6	17,4	13,7	9,9	14,1	19,4
May	1	19,5	23,1	17,8	24,2	17,1	22,9	16,6	22,7	17,7	12,8	16,8	23,2
	2	21,2	25,1	18,7	25,0	18,1	23,0	17,4	23,4	18,1	12,9	18,9	25,1
	3	22,4	26,6	19,3	26,0	18,8	24,8	17,8	23,9	19,1	13,4	18,6	24,8
	4	21,9	25,5	19,4	25,2	19,5	24,5	18,4	23,9	18,7	13,2	19,4	24,8
	5	21,2	25,8	19,7	26,1	18,7	24,5	17,9	24,4	18,9	13,7	18,6	24,7
	6	23,7	27,9	21,2	28,6	20,8	27,2	19,4	26,7	21,0	14,9	19,9	28,0
Average		21,6	25,7	19,3	25,9	18,8	24,5	17,9	24,2	18,9	13,5	18,7	25,1
June	1	23,9	28,4	21,6	28,4	20,7	26,8	19,7	26,3	20,7	14,7	20,6	26,8
	2	25,7	30,2	23,2	31,0	22,3	29,1	21,6	29,3	22,5	16,3	21,7	29,0
	3	25,6	30,1	24,1	31,0	23,0	29,2	22,3	29,4	22,5	16,2	22,4	29,2
	4	26,6	31,5	24,4	32,4	23,3	29,5	22,2	30,1	23,3	16,6	23,7	30,4
	5	26,9	31,2	25,2	32,5	24,1	29,2	22,6	30,3	23,3	16,4	23,6	30,1
	6	27,1	31,9	25,3	32,6	23,8	29,8	22,9	30,2	23,3	16,6	23,6	30,6
Average		26,0	30,5	24,0	31,3	22,9	28,9	21,9	29,3	22,6	16,1	22,6	29,4
July	1	27,1	31,7	25,9	33,4	23,8	29,8	23,2	31,0	23,6	17,0	24,3	31,5
	2	28,3	33,0	26,6	34,4	24,1	30,6	23,3	31,9	24,2	17,6	24,7	32,3
	3	27,7	32,1	26,8	34,2	24,2	30,0	23,7	31,4	23,9	17,1	25,2	32,4
	4	28,2	32,5	26,9	34,0	24,1	30,0	23,1	30,9	23,8	16,9	25,1	32,5
	5	27,1	31,4	27,0	34,1	23,7	29,2	23,0	30,8	23,5	16,8	25,1	32,6
	6	26,7	30,8	26,6	33,3	23,8	29,2	23,0	30,6	23,3	16,6	24,6	31,6
Average		27,5	31,9	26,6	33,9	24,0	29,8	23,2	31,1	23,7	17,0	24,8	32,2
August	1	26,3	31,1	26,3	33,3	23,9	29,2	22,6	30,5	23,3	16,6	24,6	31,7
	2	26,5	31,1	26,3	33,4	23,8	29,3	22,7	30,6	23,4	16,7	24,9	32,3

	3	24,6	28,9	24,5	32,0	22,8	28,2	21,6	29,6	22,6	16,2	23,6	30,6
	4	24,3	29,5	23,8	31,8	22,8	28,4	21,3	29,7	22,7	16,3	22,7	30,4
	5	22,7	27,2	23,1	30,5	21,7	26,8	20,5	28,1	21,6	15,3	22,6	29,8
	6	21,5	26,7	21,7	29,3	20,2	25,8	18,9	26,7	20,7	14,8	20,8	28,1
Average		24,3	29,1	24,3	31,7	22,5	27,9	21,3	29,2	22,4	16,0	23,2	30,5
Septem	1	20,5	25,5	20,8	28,7	19,7	25,6	18,4	26,6	20,5	14,8	20,1	27,7
ber	2	20,3	25,2	19,9	28,4	18,7	25,0	18,1	26,4	20,2	14,8	19,6	27,1
	3	17,9	22,7	18,8	26,8	17,5	22,9	16,6	24,2	18,8	13,4	18,3	25,2
	4	17,8	23,1	18,0	25,9	16,8	22,5	16,1	23,5	18,3	13,2	17,2	24,6
	5	17,7	22,5	18,1	26,6	16,6	22,5	16,1	24,1	18,6	13,5	17,6	24,9
	6	15,6	19,9	16,9	24,3	15,3	20,2	15,1	21,9	16,8	12,2	16,7	23,4
Average		18,3	23,1	18,7	26,8	17,5	23,1	16,8	24,4	18,9	13,6	18,2	25,5
October	1	14,3	18,8	15,5	23,1	13,7	19,0	14,6	21,3	15,9	12,0	14,9	21,4
	2	12,2	16,5	13,6	20,7	12,0	17,1	12,6	18,5	14,2	10,5	13,7	19,4
	3	11,3	16,3	12,5	19,9	11,5	16,9	11,3	17,8	13,9	10,3	11,9	18,1
	4	10,6	13,9	11,3	18,1	10,9	14,7	10,5	15,9	12,6	8,9	11,1	16,3
	5	8,3	12,5	10,0	16,7	8,7	12,6	8,9	14,4	11,1	8,2	9,3	14,7
	6	7,6	11,8	10,6	16,6	8,1	12,6	9,1	14,4	10,8	8,3	8,3	13,5
Average		10,7	15,0	12,3	19,2	10,8	15,5	11,2	17,1	13,1	9,7	11,5	17,2
Novemb	1	7,0	10,7	9,8	13,8	8,4	12,1	9,2	12,5	9,5	7,2	8,1	12,3
er	2	4,7	8,0	6,2	12,0	5,1	8,2	5,6	10,2	7,8	5,9	5,6	9,9
	3	3,7	7,0	6,3	12,2	5,1	8,7	5,3	10,0	8,0	5,9	4,7	9,2
	4	2,7	5,1	6,2	11,1	5,0	7,3	5,1	8,8	7,1	5,0	4,1	8,0
	5	0,5	2,3	4,4	7,7	1,2	3,4	3,7	6,3	3,9	3,7	3,2	5,7
	6	1,0	3,3	4,0	8,5	2,1	4,2	3,3	6,7	4,8	3,9	2,0	5,5
Average		3,3	6,1	6,2	10,9	4,5	7,3	5,4	9,1	6,9	5,3	4,6	8,4

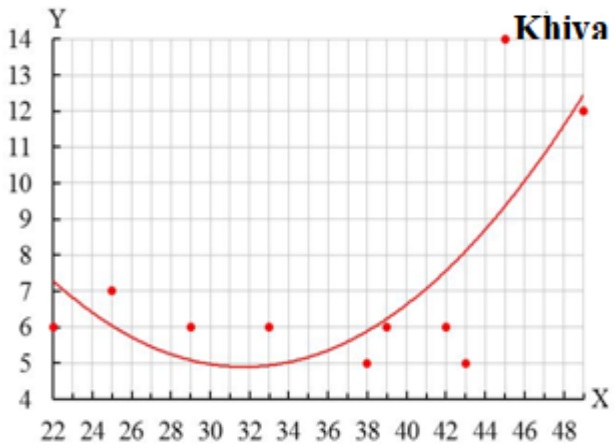
Note: Average air temperature on dates 1 - 1-5, 2 - 6-10, 3 - 11-15, 4 - 16-20, 5 - 21-25, 6 - 26-30 (31)

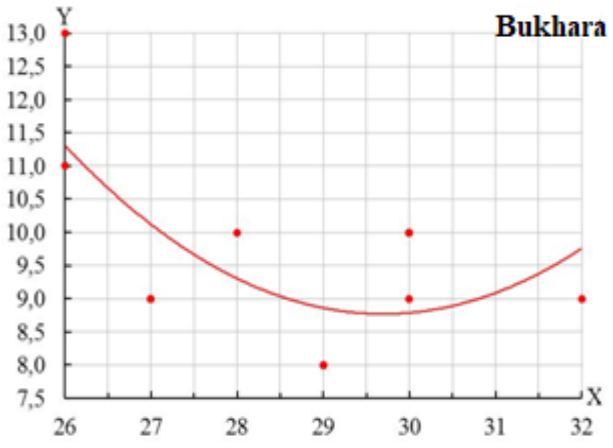
As can be seen from Table 1, the difference in air temperatures during the day and night varies from station to station in the following range: in Khiva in the northern region in spring – 2,0÷3,5 °C, in summer – 4,0÷5,0 °C, in autumn – 3,0÷5,0 °C; in Shakhrisabz in the southern region in spring - 4,0÷6,5 ° C, in summer - 6,5÷7,0 °C, in autumn - 4,5÷8,5 °C; in the central regions in Bukhara in the spring – 3,0÷5,5 °C, in the summer – 5,5÷6,0 °C, in the autumn – 3,0÷5,5 °C; In Dahbet in spring - 3,5÷6,0 °C, in summer - 6,0÷8,0 °C, in autumn - 3,5÷7,5 °C; In Yangiyul in spring – 3,5÷5,5 °C, in summer – 6,0÷6,5 °C, in autumn – 3,5÷6,5 °C; In the Fergana Valley in spring – 4,0÷6,5 ° C, in summer – 6,5÷7,0 °C, in autumn – 3,5÷7,0 °C. These data allow to assess the thermal regime of the area for five and ten days during the agro-technical and other work on crops in the agricultural sector at different periods of observation.

When creating a method of forecasting the yield, it is important to know first of all the multiplicity, importance and time variability of the factors influencing it, the signs of inertia. It takes a long time from planting cotton and grain crops to harvesting. The effect of temperature is especially noticeable during the development period, and in the formation of the crop, the percentage of temperature varies depending on its phase.

Below are the differences in air temperature collected during different observation periods on the basis of observational data on cotton (Khorezm-127, Namangan-77, S-6524, Bukhara-8) and wheat (Polovchanka, Tanya) varieties grown around Khiva, Shakhrisabz, Fergana, Bukhara stations. the phase-to-phase dependence of the plant height on the phases was studied.

Figure 1 shows the dependence of the plant height in the 3rd petal phase of cotton on the duration of the period from planting to the 3rd petal phase.





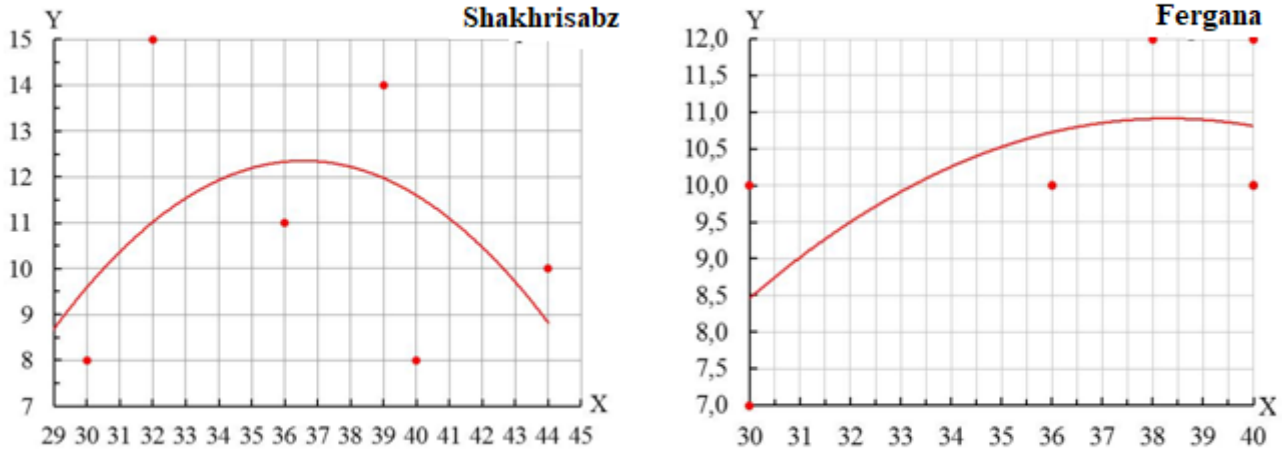


Figure 1. Dependence of plant height (Y, cm) in the 3rd petal phase on the duration of the period (X, days) from planting to the 3rd petal phase

As can be seen from Figure 1, the plant height in the 3rd petal phase of cotton-plant reached its maximum value in 45-49 days at Khiva station, 26-27 days in Bukhara, 34-39 days in Shakhrisabz, and 38-40 days in Fergana.

A similar situation is based on the data of Polovchanka and Tanya varieties of winter wheat, which show that the plant height between phases depends on the duration of the period from phase to phase (Figure 2).

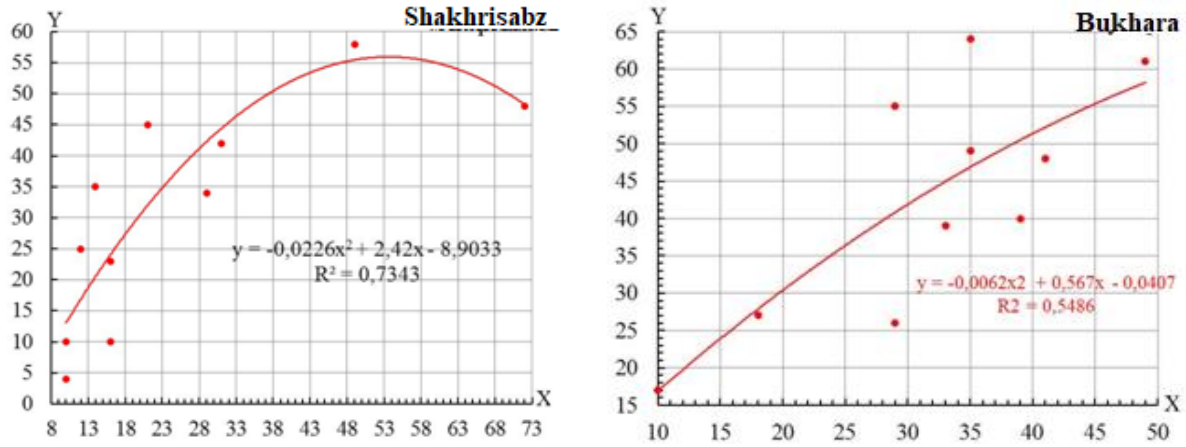


Figure 2. Dependence of the length of the plant (Y, cm) on the formation of the lower link-sprouting phase on the duration of the period (X, days) before the emergence of the lower link-sprouting phase

If we pay attention to the trend line in Figure 2, the maximum height of the plant in the lower stage of winter wheat is 48-58 days in Tanya (Shakhrisabz) and 40-50 days in Polovchanka (Bukhara).

One of the main reasons for this is that the areas where cotton and winter wheat are grown are related to the soil-climatic regime of the region and the characteristics of the varieties.

Let us now consider the effect of air temperature at different observation periods on the cocoons formed in the cotton (Figures 3-5).

Figure 3 shows the dependence of the number of blocks formed at different phases at the Fergana station on the sum of air temperatures during the observation periods 05^{00} and 14^{00}. The equations show from the correlation coefficient (Figure 3) that the air temperature at 05^{00} h has a positive effect on the formation of cores.

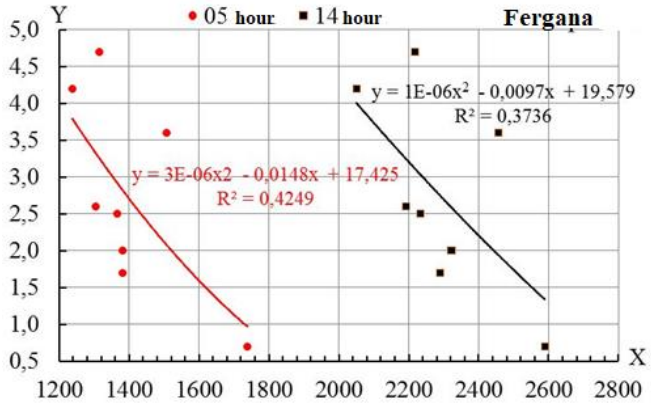


Figure 3. Dependence of the number of unripe cotton bell (Y, pieces) formed at the Fergana station on the flowering phase on the sum of air temperature (X, ° C) for the observation periods of 05^{00} and 14^{00} hours

Figure 4 shows the dependence of the unripe cotton bell formed at Khiva station on July 29 on the temperature

accumulated during the observation period from planting to July 29 at 05^{00} and 14^{00} hours.

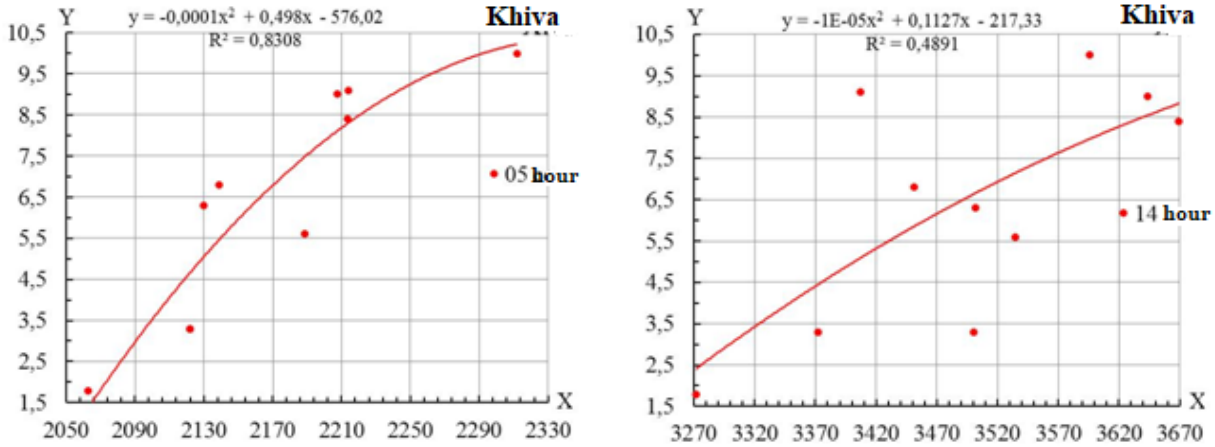


Figure 4. Dependence of the unripe cotton bell (Y, pieces) formed at Khiva station on July 29 on the temperature (X, ° C) accumulated during the observation period from sowing to July 29 at 05^{00} and 14^{00} hours

The equations show from the correlation coefficient (Figures 3 and 4) that the air temperature at 05^{00} h has a good effect on the formation of the unripe cotton bell.

At the Bukhara station, the dependence of the unripe cotton bell formed before the flowering phase on the accumulated temperature during the night (02^{00}, 5^{00}, 20^{00}, 23^{00} hours) and daytime (08^{00}, 11^{00}, 14^{00}, 17^{00} hours) observation periods from planting to flowering phase (Figure 5).

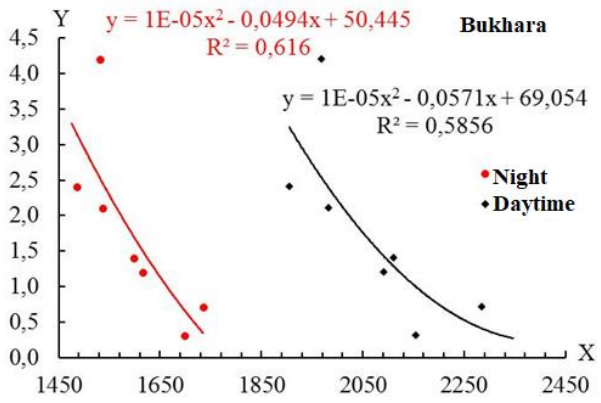


Figure 5. Dependence of the unripe cotton bell (Y, pieces) formed at the Bukhara station on the accumulated temperature (X, ° C) during the night (0200, 500, 2000, 2300 hours) and daytime (08^{00}, 11^{00}, 14^{00}, $17^{0}0$ hours) observation periods from sowing to flowering phase

It can be seen from this picture that the correlation coefficients show that the effect of nighttime temperatures on the increase in the number of unripe cotton bell formed before the flowering phase of cotton is high.

Conclusions and Suggestions

In the cultivation of cotton and grain crops in Uzbekistan, it is important to increase the population, the "consumption" of certain agricultural lands for various purposes, due to the agro-climatic features, the rational use of irrigated lands and the full temperature regime of the region.

Data on the amount of air temperature for five and ten days at different periods of observation allow to assess the thermal regime of the area when conducting agro-technical measures on agricultural crops.

Phases of development of winter wheat and cotton plants The influence of the duration of the period on plant height is associated with the temperature regime of the air in spring and summer.

Given the current per capita volume of agricultural crops grown in Uzbekistan and population growth, special attention should be paid to the rational use of thermal resources to increase productivity in the future.

Based on the above considerations, we believe that future research in the following areas will be of great scientific and practical importance:

- Determining the dates of transition to different levels of air temperature in autumn and spring and the optimal planting dates;
- assessment of agro-climatic conditions of irrigated areas;
- Determination of agrometeorological indicators for the phenological phases of new varieties recommended in the regions;
- Further improvement of productivity elements and yield forecasting methods, taking into account the characteristics of modern climate change, etc.

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