Periodicity Of Growth And Crop Formation In Intraspecific Forms Of Wheat

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Abstract: The data presented in this article indicate the high resistance of wheat population forms to the effects of unfavorable low air temperatures and the ability of growth processes in a large range of temperature coefficients compared to the control variety. The dependence of the growth rates of the studied forms on the average daily and maximum daily air temperature and the duration of negative temperature during the day in the conditions of low autumn temperature is shown.

Key words: wheat breeding, folk selection, soft wheat, organogenesis, organs, ecological balance, plant, forms.

Introduction

Modern wheat breeding is mainly based on the use of the world gene pool of cultural species. However, most of the modern varieties are not sufficiently resistant to environmental stressors, which leads to a decrease in their productivity. Native old variety populations of spring soft wheat are more protected. Their ability to quickly adapt ensures a high percentage of survival in the conditions of industrial activity of man and disruption of the ecological balance in nature.

Due to this important factor, the involvement of the gene pool of the ancient variety populations of local people's selection in wheat cultivation serves to increase the productivity, plasticity, and stability of these crop varieties, and to ensure a large amount of stable high-quality harvest.

Studying the intensity and direction of growth processes in plants makes it possible to determine the possibility of increasing their productivity by regulating fluctuations in growth intensity caused by individual genetic characteristics of the plant organism and the influence of exogenous factors.

At the moment, it is not enough to study only the phase rhythms of plant growth to develop scientifically based methods of increasing the yield of spring wheat. It is also necessary to monitor the growth of plants on a daily basis, which means constant information about the accumulation of the crop and the level of satisfaction of the plants' needs for basic nutrients, a certain temperature, light and humidity. allows to have information.

Materials and Methods

The research is based on methodological manuals "Methodology of field experience in vegetable growing and melon growing", "Guidelines for ecological testing of vegetable crops in open ground" and "Methodology of physiological and biochemical research in vegetable growing and melon growing", "Methodology of conducting experiments in vegetable, vegetable and potato growing" was carried out. The statistical analysis of the research results was carried out based on the dispersion method shown by B.A. Dospehov “Methodology of field experience” (1985) using Microsoft Excel program.

Results

The obtained experimental data made it possible to conduct a comparative analysis of the laws of growth processes in various intraspecific forms depending on the genomic composition of spring soft wheat and natural-climatic conditions of growth and to identify similar and unique characteristics.

Air temperature was found to be the leading factor in determining the daily growth frequency of all studied forms at all stages of organogenesis (Figs. 1, 2, 3). Analysis of the dynamics of daily periodicity of F1 and F2 hybrid combinations revealed the following.

At all stages of organogenesis, these forms are characterized by a clear diurnal periodicity in the growth rate of whole plants and their individual organs, with a maximum during the day (from 11 to 18 hours) and a minimum during the morning hours (from 5 to 7 hours).

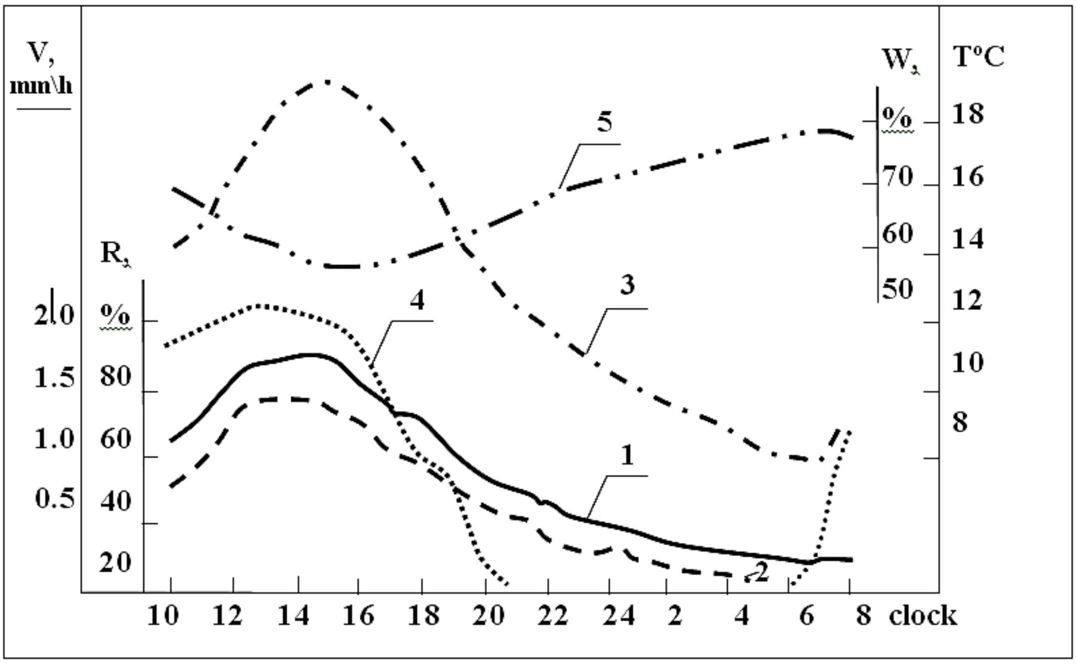

Figure 1. Daily growth dynamics of the F1 (K-55563 x K-24596) form during the I - IX stages of organogenesis: 1 - growth rate, V, mm/hour; 2 - growth rate control - (Siette Cerros 66); 3 – air temperature, T°C; 4 – relative air humidity, W%; 5 - duration of solar radiation, R%.

The most obvious sinusoidal characteristic of the growth rate curve for all studied forms of combinations is during the period of maximum potential growth of the plant stem (stages VI-VIII of organogenesis), when the amplitude of growth rate fluctuations per day reaches 4-5 cm appears.

The analysis of the relationship between the daily growth of plants and air temperature showed that, depending on the stage of plant development, the correlation coefficient was from 0.68 to 0.97. The highest degree of correlation between growth processes and air temperature was observed during the period when plants passed IV-VII stages of organogenesis (loading stage, Table 1).

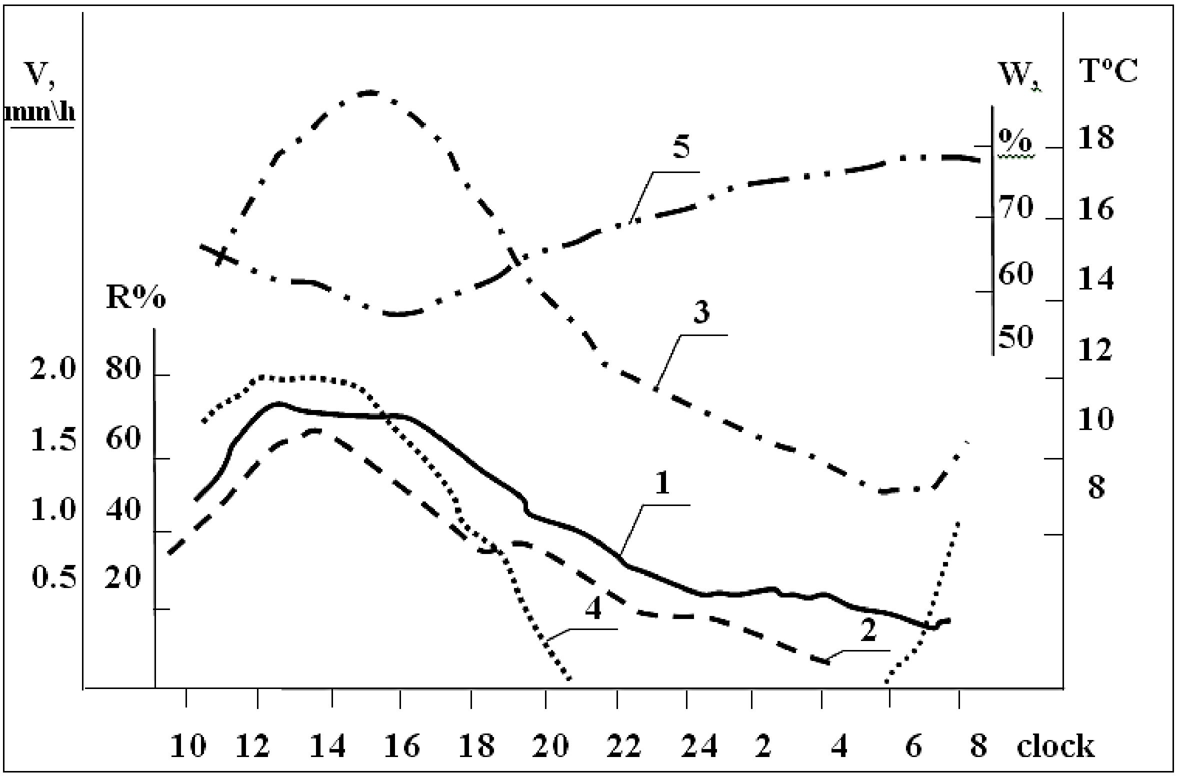

Figure 2. Daily growth dynamics of the F2 (K-55563 x K-55571) form during the I-IX period of organogenesis. 1 - growth rate, V mm/h; 2 - growth rate control (Siette Cerros 66); 3 – air temperature, T°C; 4 – relative air humidity, W%; 5 - duration of solar radiation, R%.

Against the background of optimal air temperature and the duration of sunlight, it was found that the growth processes in all studied forms of wheat are accelerated. An increase in these indicators slows down the rate of growth processes during certain hours of the day.

The deviation of the growth curve from the sinusoidal temperature curve, the sudden change in the growth rate due to the change in temperature caused differences between the daily growth direction of the control variety and the hybrid combinations. For example, in the Siette Cerros 66 control, the growth curve often varied during the day, during the most intensive growth period, and during the evening and night. However, the combination of K-55563 x K-24596 showed an increase in growth intensity during the hours when the air temperature increased by 0.3-0.5 °C or remained unchanged for one hour.

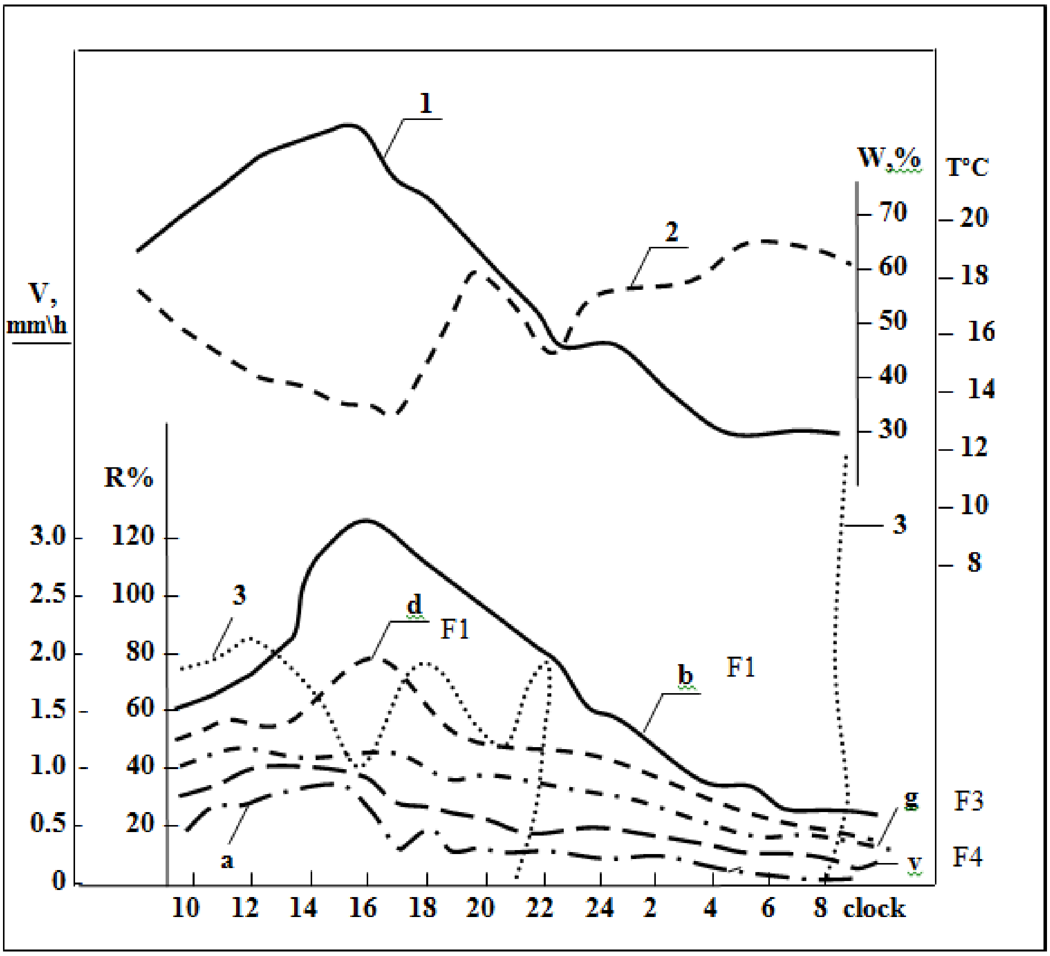

Figure 3. Dynamics of daily growth periodicity of intraspecific forms of wheat. (a); F1 (K-55563 x K-24596) (b); F2 (K-55563 x K-55571) (v), F4 (K-55572 x K-56572) (g) and F3 (K-53571 x 24596) (d). 1 - growth rate, V mm/h; 2 - growth rate control (Siette Cerros 66); 3 – air temperature, T°C; 4 – relative air humidity, W%; 5 - duration of solar radiation, R%.

During the years of the experiment, the forms studied with control in stages II-VII of organogenesis showed the maximum growth rate at 12-14 hours, which did not correspond to the highest air temperature observed at 15-18 hours.

For example, in the combination of K-55563 x K-24596, the discrepancy between the air temperature and the maxima of the growth processes for 3-4 hours was caused by the inhibitory effect on the growth of high-intensity solar radiation. the highest temperature and low humidity during these hours of the day.

On normal days, at normal air humidity for growth and optimum air temperature, the maximum growth rate of plants does not always correspond to the maximum air temperature. This shows that endogenous rhythms of growth processes, which cause maximum changes in growth rate, appear in the early hours of the day in the studied forms compared to the control.

Table 1

Indicators of the correlation coefficient between the speed of growth processes and air temperature at different stages of organogenesis of wheat forms

Forms	Stages of organogenesis			
	III	IV-VII	VIII	III-IX
Control	0.86±0.03	0.84±0.03	0.81±0.03	0.92±0.04
F1	0.74±0.02	0.93±0.04	0.96±0.04	0.97±0.05
F2	0.80±0.03	0.82±0.03	0.81±0.03	0.93±0.04
F3	0.84±0.03	0.86±0.02	0.68±0.02	0.90±0.04
F4	0.70±0.02	0.88±0.04	0.89±0.04	0.91±0.04

Note: the obtained values are significantly different from the control variant at $R<0.05$.

The minimum phases in the curves of growth and temperature coincided with each other and decreased by 6-7 hours and extended by two hours. As a result, with an increase in air temperature, the intensity of growth processes remained at a constant level for one hour.

This shows that these forms of wheat combination, unlike the control, are more sensitive to fluctuations of the temperature coefficient and quickly respond to an increase in its values after a long decrease.

Differences in the degree of influence of air temperature on the growth processes of the studied wheat forms were manifested in the minimum average daily temperature values, where the height growth of the plants did not decrease. The minimum air temperature for linear plant growth in wheat forms of the K-55563 x K-24596 combination reached -4 °C, which was slightly lower than the minimum control temperature.

The highest level is typical for the crossing combination K-55563 x K-55571, where no linear increase in height was observed at mean daily air temperature below 2.6 °C.

With mean daily air temperature ranging from 3.5 to 4.5 °C, the highest values of daily elevation are K-55563 x K-24596 and K-55571 x K-24596 (2.15 and 2 ,35) differ in wheat forms. mm/day, respectively). In the control cultivar Siette Cerros 66, the growth rate during the autumn growing season was lower than the study average for three years and was 1.64 mm per day.

Determining the optimal air temperature limits for the linear growth of plant forms made it possible to identify a number of distinguishing features between them. For example, in the combination of K-55571 x K-24596, the maximum hourly increase in height was observed at an air temperature of 24-28 °C.

The K-55563 x K-24596 combination, in contrast to the K-55571 x K-24596 combination, is characterized by the maximum rate of growth processes at a relatively low value of air temperature - 18-20 °C. In all years of research, the highest growth rates were observed at the same values of the temperature factor.

At the same time, it was found that the optimal air temperature limit was shifted to 20-26 °C in the combination of K-55563 x K-24596, which indicates a wider reaction rate in relation to the temperature factor.

The results of the research showed that the change of relative air humidity up to 30-50% in most cases does not disturb the daily periodicity of the growth of the studied forms.

The influence of the duration of solar radiation on the growth processes of all studied forms was uncertain and depended on the age of the plants and the values of the temperature regime.

In all studied forms of wheat, their rate has been shown to change with plant development. However, the maximum daily growth of height for each combination occurred at different stages of organogenesis. According to the study, the K-55563 x K-24596, K-55563 x K-55571, K-55571 x K-24596 and K-55572 x K-56572 combinations were averaged over three years. control variety, the maximum intensity of growth processes differs in the heading stage.

It was found that the studied forms of wheat in the initial phases of vegetation differ from each other in the dynamics of dry biomass accumulation. Thus, for example, in the early stages of vegetation, the combination K-55563 x K-24596 occupied an intermediate position, while at the stage of ear formation, it exceeded the control and other combinations in this indicator.

During the period of intensive growth (mid-April), a significant advantage of the K-55563 x K-24596 combination over other crossing combinations was noted.

Daily increase in dry biomass calculated per 1 m2 planting was higher in combination K-55563 x K-24596, which is explained by its significantly larger leaf area than other crossing combinations. In the early stages of the growing season, the K-55563 x K-24596 combination was 2.5-3.0 times higher in dry biomass growth than both the control and other crossing combinations.

The results of determination of the assimilation surface of wheat-shaped leaves showed that the leaf surface of F-1 combination plants was greater than other combinations at all developmental stages. For example, in terms of leaf surface area (FL), this combination increased 3.5 times more than the F-3 combination and 8 times more than the control.

Parameters such as photosynthetic potential (PP) of plant leaves, daily increase in dry biomass of plants and each organ during grain formation were used to determine the reasons that determine the increase in economic productivity of the studied wheat forms. was studied.

It is shown that the increase in dry biomass of the whole plant is represented by a raised curve. The combination K-55563 x K-24596 was distinguished from the control and other studied forms of wheat by a significant increase in total dry plant biomass.

Accumulation of dry biomass in leaves in the studied forms, K-55563 x K-24596 is represented by a two-peaked curve with a peak at the tuber stage when the maximum growth reaches 4-6 g/plant, control . - 1.5 g / plant. In wheat forms, a second, less pronounced peak was observed at the milk ripening stage. At the stage of grain formation of the studied forms of wheat, the combinations K-55563 x K-24596 and K-55571 x K-24596 intensively accumulated dry weight in all plant organs compared to the control.

It is shown that the balance of biomass between organs in the flowering phase shows that the relative shares of ear, leaf and stem in the total yield of the studied forms of wheat have changed slightly during the years of the study.

Conclusion

The results of the conducted research showed that the daily height growth of wheat and the daily maximum value of growth increase with the age of the plants. To a large extent, these indicators converge with the rate of accumulation intensity of dry plant biomass. During ontogenesis, the dynamics of dry plant biomass accumulation resembles a two-peaked curve with a maximum at the stage of evaporation and grain filling.

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