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TO STUDY THE HEAT RESISTANCE FEATURES OF BREAD WHEAT VARIETIES AND SPECIES FOR THE SOUTHERN REGIONS OF THE REPUBLIC OF UZBEKISTAN

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Abstract: Wheat (Triticum aestivum L.) is considered one of the world's most important cereal crops. Every year 704 million tons of grain is produced worldwide. Bread wheat croplands cover 17% of the total crop area. In recent years, sudden changes in air temperatures have a negative impact on the morphological, physiological, biochemical and molecular properties of wheat and grain yield. Therefore, it is important to create high-yielding and resistant varieties of bread wheat to abiotic factors and to develop its primary source in the condition of different regions. In the result of this study, the influence of high temperature which varied from 30°C and above continuously during spiking and maturation period of grain, especially in the period of grain filling, on grain quality and productivity has been studied thoroughly for southern parts of Uzbekistan. Mostly, winter bread wheat varieties are grown in these southern regions. The optimal sowing time in autumn season is the second decade of October. In order to determine the heat resistance of the winter wheat varieties that are mostly grown in the Republic and selected in the result of breeding, the experiments and observations were carried out on optimal and late sowing periods. The optimal planting time was found to be appropriate on the 15th of October and for late sowing the 15th of November. At the same time, late sown varieties and samples are divided into resistant and non-resistant groups due to the delay in the maturation period and greater exposure to heat. At the study, temperatures during the growth period were calculated and daily temperatures during the grain filling period were determined too, and the influence of air temperature on growth phases, height of plant (cm), spike length (cm), number of spikelets in a spike (pieces), grain weight in a spike(g), weight of 1000 grains (g), grain nature (g/l), protein amount (%), gluten amount (%), its changes and the results in optimal and late periods were studied by comparing them.

Keywords: bread wheat, variety, species, heat resistance, air temperature, growth phases, grain quality.

Introduction

As a result of global climatic changes, the great attention is paid to increasing grain productivity through creating wheat varieties resistant to different abiotic factors in cereal producing countries such as the United States, Canada, China, India and Russia. Improving the productivity and quality of cereal crops, including bread wheat, is one of the most important tasks in today's food security. Several factors influence on the growth, development and productivity of wheat varieties during the last spring months and summer months. In this case, scientific research on the creation of new high-yielding and precocious varieties with high quality of grain, resistant to various external stress and evaluation of hybrid species is of great importance and relevance.

After gaining independence, large-scale measures were taken to develop agriculture, including grain growing. As a result, grain independence was achieved in a short time. At the same time, special attention should be paid to the research on the development of selection of wheat varieties that are tolerant to abiotic factors, namely, the drought, heat and hot wind.

According to the Food Agriculture Organization (FAO) and CIMMYT, the demand for food in the world, including grain, has been increasing in recent years. Because the people meet about 60% of their protein needs with cereals. In the future, this problem will only increase. Worldwide, the area of grain crops is 840 million hectares, of which 227 million is wheat croplands. Wheat is cultivated as the main crop in more than 180 countries around the world. However, its productivity is much lower than the potential level of 27,1 c/ha. This means to meet 60% of the population's grain needs. Today, the European Union is the largest producer of wheat (123 million tons) and China ranks the second (96 million tons), India is in the third place (72 million tons), on the 4^{th}place –the US (68 million tons), Russia ranks the fifth (63 million tons). The largest grain-consumers are the European Union (EU) countries - 120 million tons, China - 100 million tons, India 75 million tons [1].

According to the decision of the State Commission for testing agricultural crop varieties of the Republic of Uzbekistan, more than 40 varieties of wheat have been included in the State Register, of which more than 20 are considered local varieties of wheat that were created in local condition [2]. Spiking stage of winter wheat in Uzbekistan occurs in dry and hot season. Rainfall in late April and early May almost does not affect the yield of winter wheat. During this period, the amount of precipitation is low and can only moisten the soil surface. Flowering and pollination occur naturally at a temperature of 11-30°C. When the air temperature is 20-25°C, these processes accelerate. If the soil has enough moisture and air temperature is 25-30°C, flowering and pollination are normal. The duration of spiking, flowering and pollination varies from 5-8 days to 10-12 days [3].

It was observed that drought and heat with high temperatures affected up to 40% to the late-sown wheat fields [4], but drought resistance did not occur at the same rate throughout the wheat growing period [5]. Studies showed that photosynthesis in the awned spike increased twice. Awns developed later and preserved photosynthetic activity which indicated drought resistance of the variety [6].

In developing countries 32% of wheat varieties are exposed to heat during the growing season[7]. Local type wheat varieties grown in Central Asia are heat-resistant. Detrimental temperature which causes to coagulation of protein in the plant is found to be +55+56 °C at early growth phase of the plant while at spiking and grain filling phase it can be +61 °C [9], the wheat varieties that belong to another ecotype are the most resistant to + 56,6

°C + 58,2 °C [8]. Wheat grows very well at temperatures from +15 to + 25 °C, and its productivity decreases when the temperature increases, that is, reaches + 25°C [10]. If the temperature and humidity are high during the flowering period of the wheat and the plants stay at 30°C temperature for 3 days, then the flowers of the crop will be infertile and the grains will be reduced by 68% [11].The optimal air temperature for the growth of the wheat is appeared to be 18-24 °C. When air temperature reaches 28-32°C for 5-6 days, there is a 20% drop in productivity [12]. Using the abovementioned scientific data, the productive and high-yielding varieties and species of wheat with best quality grain and resistant to heat, have been selected.

Materials and Methods

Field experiments were conducted in Karshi experimental field of theKashkadarya branch of the Research Institute of Grain and Leguminous Crops for the period of 2012-2014. Laboratory experiments were carried out in the branch laboratory "Determination of technological quality and physiology of grain quality". Experimental positioning and phenological observations, calculations and analyzes during the experiments (All-Union Institute of Plant Industry - VIR, 1984) and biometric analyzes were conducted according to the methods of the State Testing Commission on agricultural crop varieties (1985, 1989). Technological characteristics of winter wheat grain cultivated in the experimental field were compared with the data of manuals "Methodological recommendation for the evaluation of grain quality", "Methods of biochemical study of plants", with gluten content GOST 13586-1-68, grain glassy color GOST 10987-76, grain moisture GOST 13586-5-93, grain nature GOST 3040-55, weight of a 1000 pieces of grain GOST 10842-89. Statistical analyzes were performed based on the method of Dospekhov (1985).

The field experiments scheme of the research was based on the Complete block design and Alpha lattice design of Genestat 3 program. 105 varieties and samples were compared by heat resistance having been planted in the optimal (October 15) and late (November 15) sowing periods, and the influence of heat was studied during grain prolification period on the productivity parameters of late-sown grains.

The amount of chlorophyll particles in the plant leaf was measured on a SPADMETR device every ten days after the spiking phase. This device measures the amount of chlorophyll in the 2-3 mm area of the leaf. Green color changes in the plants were determined on the GREENSEEKER device every fifteen days after the shooting stage. GREENSEEKER device weighs 6 kg. It measures the green parts of the plant using infrared radiation. The device receives 650 and 770 nm of rays from the plant, and the number displayed on the monitor is called the normalized difference of the vegetative index (NDVI). This instrument measures the chloroplasts in the plant body on a scale of 0.1 to 1. The higher the number of the scale, the greater the body of the plant has chloroplasts, i.e. the green mass, and play an important role in the development of harvest elements. It isfound that the correlation between NDVI and wheat grain yields is highest at the time of nodes formation and flag formed leaf formation at the plant stem.

Results and Discussion

During the study of the optimal and late period varieties and samples in the research, the period of "spiking-maturation" varied accordingly. The shortest "spiking-maturation" phase was observed in the experiments during 2012 and 2014. This is due to the fact that the average daily temperature in the spring during these years was much higher than in other years. The highest daily temperature data was obtained during the “spiking-maturation” stage and the sum of the temperatures obtained by the varieties and samples during that period and the average daily temperature were calculated. In the late period, however, due to late beginning of the spiking stage and rapid maturation under intense heat effects, the spiking maturation period can be shorter.

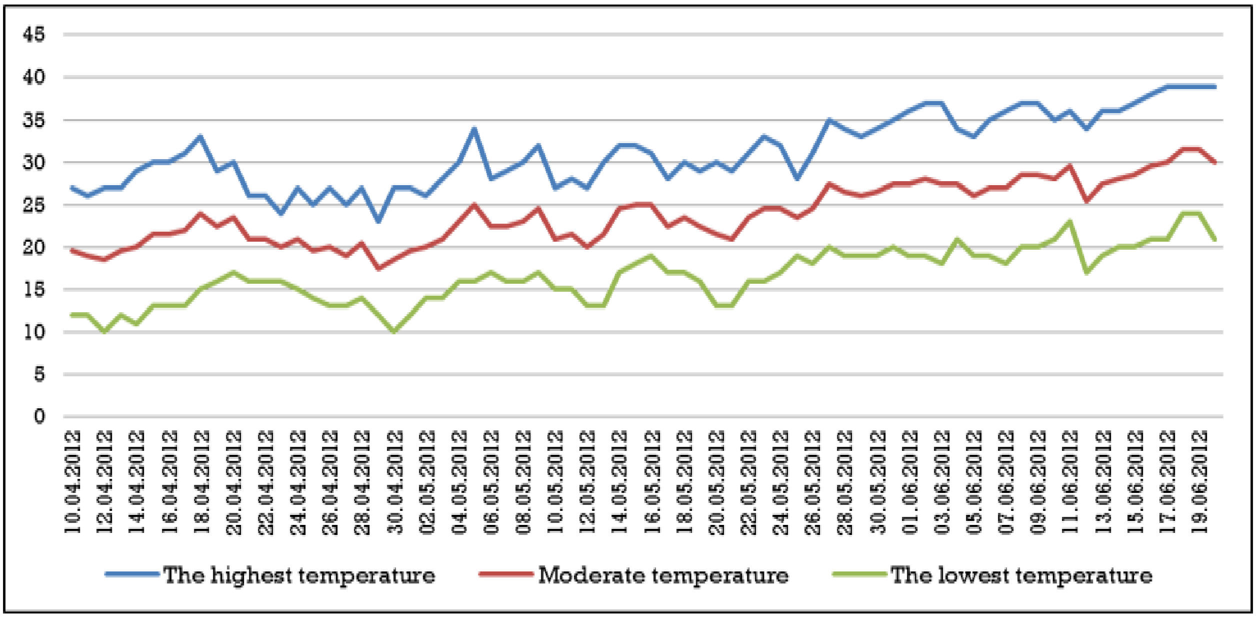

Fig. 1. Air temperature at the stages spiking - maturation (2012).

When the effects of heat (temperature) on spiking maturation stage were investigated, the study found that in 2012 spiking-maturation stage of bread occurred in warm days in late period. After May 4, temperatures above 30°C have affected the productivity parameters of varieties and samples.

Particularly, after May 30, an increase in temperature up to 35-37°C led to the rapid maturation of varieties that are non-resistant to heat. As a result, there were observed a short grain filling period and a sharp decline in the parameters of farm-valuable traits of varieties in late period than in optimal period (Figure 1).

According to the results, the spiking maturation stage of the varieties and samples constituted 36-50 days in optimal time. It was observed that the spiking stage occurred in optimal period between April 16 and May 3 while in late period between April 28 and May 15.

The full maturation period was recorded on June 2-9, and in late period – June 6-17. The average air temperature for this period was 27-30°C, while the highest air temperature in those days was 35-39°C. At such high temperatures, there was a rapid maturation of varieties and samples.

Analyzing the results of the research, it was noted that the standard Krasnodar-99 variety’s transition to full spiking phase under optimal planting conditions was on April 27 while under late sowing on May 6, with full maturity on June 6, and in late sowing on June 14. Spiking-maturationstageconstituted 40 days in the optimum time, 39 days in the late period, the average temperature at these times was 964 °C in the optimal period, 1012.2 °C in the late period, the temperature in one day made 24.1 °C in the optimal period while in the late period it was 26 °C, the yield was 51,3 c/ha in the optimal period, in the late period it was 36 c/ha, and the weight of 1000 grains was 40,2 g for the optimal period , 31,7 g for the late period.

Consequently, the spiking stage began 9 days later than in the optimal sowing period and as a result of rising temperatures during the "spiking-maturation" period, one day's temperature was 1,9 °C higher than in the experiment sown in optimum period.In result, variety productivity decreased by 15,3 c/ha, weight of 1000 grains by 8,5 g. According to the results, among varieties and samples KR11-105-43 sample was sown in optimal period, its productivityconstituted 74,3 c/ha, weight of 1000 grains was 47,7 g, in late sowing period these indications were 63,7 c/ha, and 42,0 g respectively,which showed the highest result (Table1).

In 2013,the temperature during spiking maturation stage created favorable conditions for the selection of heat-resistant varieties and samples. On April 10-14, the temperature increased to 27-30 °C, and after April 20-22 the temperature rose to 26-31 °Cdegrees. On May 1-13, the highest air temperature reached 25-30 °C degrees. On May 14-18, the temperature increased to 32-37 °C. Subsequently, by the end of the spiking maturation period, the temperature increased to 41 °C (Figure 2).

The transition of varieties and samples, which were sown in optimal period,to full spiking phase occurred from the 7th April to the 28th of April.

The spiking maturation stage made 42-59 days. The average air temperature for this period was 926-1268.5 °C. The air temperature of one day was 20,9-24,3 °C.

The productivity of the variety and samples were found to be 31.0-87.1 t/ha. Temperature of 30-35 °C and above had a significant impact on productivity. It was noted that in the optimum period the weight of 1000 grains of varieties and samples was 32.2-47.4 gr.

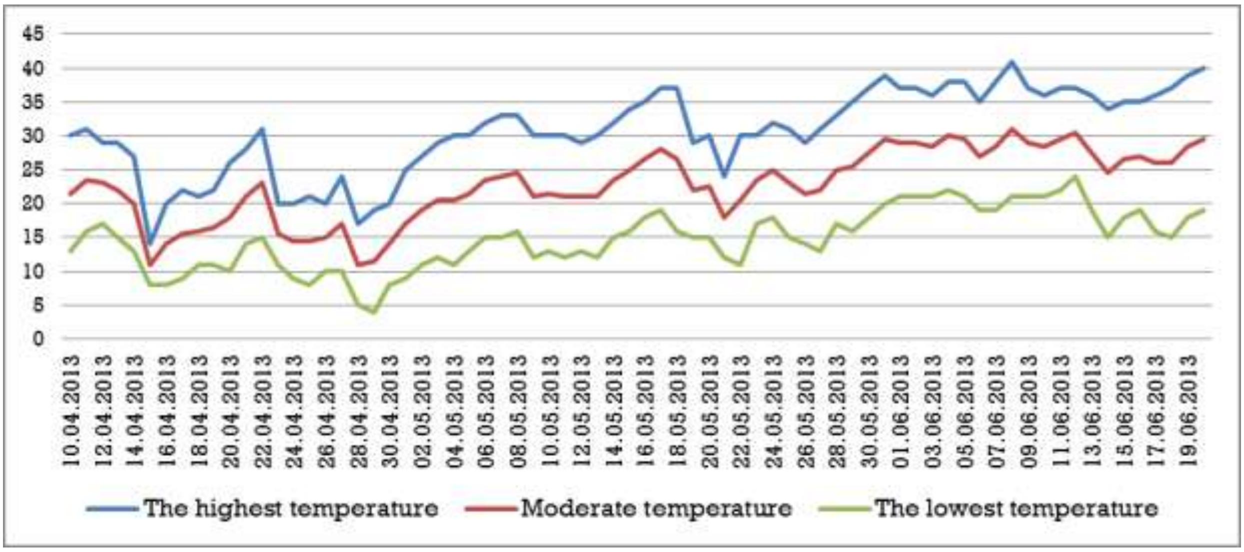

Fig. 2. Air temperature at the stages spiking - maturation (2013).

Compared to the optimum period, it was found that in the late period, the weight of 1000 grains of the varieties the samples reduced to 13,2 g. According to the results of the study, the average spiking maturation period of the standard Krasnodar-99 variety made 45 days for the optimum period, 46 days for late period, the total temperature sumwas 1014 °C at the optimum time, 1070 °C at the late period and the temperature for one day was 22.5 °C at the optimum time while in the late period it was 23,3 °C, the weight of 1000 grains in the optimal period constituted 36,2 gr, in the late period 35,5 gr, the productivity in the optimum period was yield 63,4 c/ha, in the late period 42,7 c/ha.

It is clear that the increase in daily temperature by 0.8 °Ccaused the decrease in the weight of 1000 grains by 0.7 g/ha and the productivity by 20,7 c/ha (Table 2).

According to theobservation results conducted in 2014, on April and May, the temperature increased to 26-30 °C on April 19-24. Especially,from May 1, the maximum temperature to 35°C and above and reached 40 degrees Celsius by June 11.

As a result of late transition of varieties and samples, which were sown in late period, into the late spiking phase and late flowering, this period occurredat temperatures of 30-35°C and above. Accordingly, incomplete pollination led to a decrease in the number of grains in an ear.

According to the results of scientific researches, the optimal period of sowing of varieties and samples lasted from April 16 to May 5, and from April 23 to May 10 (Fig. 2). Transitionto full maturation phase was recorded in the optimum time from May 30 to June 8, and in late sowing period on June 6-12.

It was determined that in the optimum period the spiking maturation stageconstituted 34-49 days and in the late period32-46 days. The sum of temperatures of the variety and samples during the period of spiking and maturity made 858-1186.5 °C at optimum time, 811.5-1126.5 °C in the late period, and the average daily temperature was 23.4-25,4 °C at optimum time and 24,5-25,70C in the late period,the yield constituted 29.8-79.5 c/ha in optimal period while in the late period 30.8-65.2 c/ha.

The standard Krasnodar-99 variety'sspiking period made 41 days, while in the late period 40 days, average daily temperature was 24.7 °C in optimal time while in late sowing time it was 25.6 °C, the yield was 64.8 c/ha in optimal time while in late time 41.4 c/ha. It can be seen that the productivity of the variety decreased by 23.4 c/ha when the temperature increased by 0.9 °C (Table 3).

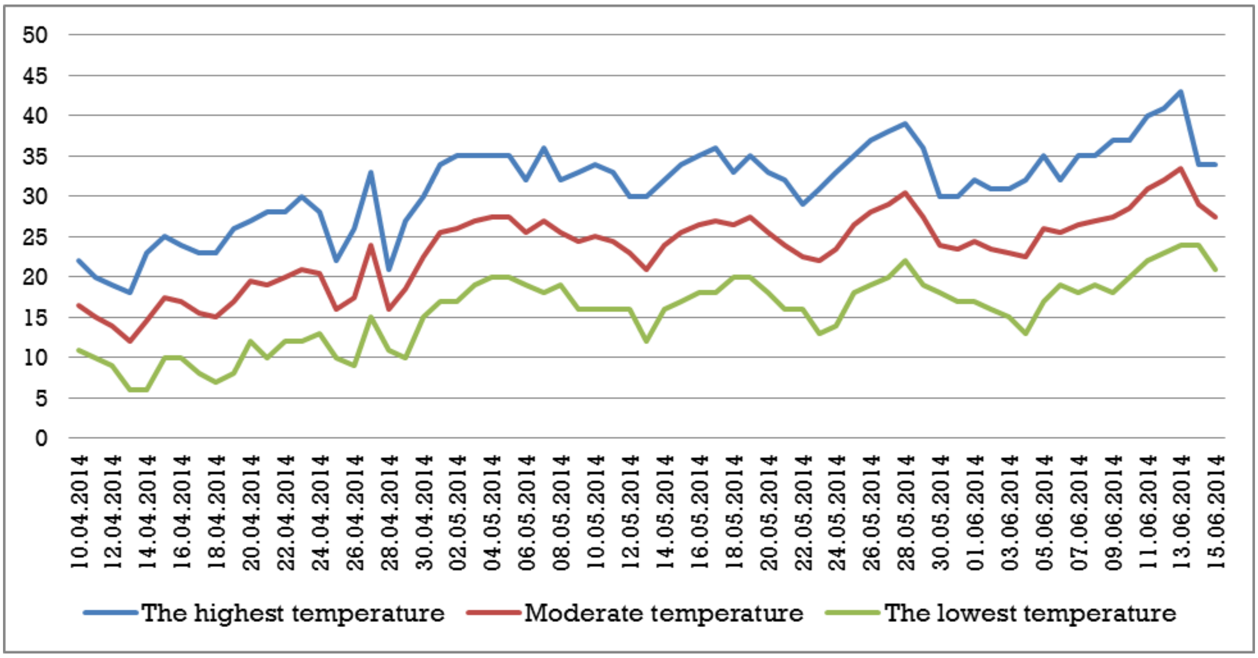

Fig. 3. Air temperature at the stages spiking - maturation (2014).

It was found that there is a significant correlation between the length of the spiking-maturation stage and the grain quality characteristics, protein content (r = 0,11) and gluten content (r = 0,24). Also noted the positive correlation (r = 0,03) between the yield and spiking maturation period of the varieties and samples that are studied by sowing in the late period, as well as, a strong correlation (r = 0.07)of the spiking maturation period with the weight of 1000 grains, a positive correlation between the spiking maturation period and protein content (r = 0,05) and gluten content (r = 0,06).

While analyzing three year results, KR11-105-43, KR11-105-44, KR11-105-45, KR11-105-50, KR11-105-59, Gozgon, Turkiston, Bunyodkor, Farovon, Barhayot, KR11-105-42 varieties and samples with short spiking maturation stage and high yield were selected.

Productivity. Indicators of productivity of the studied varieties and samples showed that there were varieties and samples with high yielding and almost similar productivity both in optimal and late periods.

The main purpose of the research is to determine the heat resistance of varieties and sample, whose productivity indicators are particularly important for optimal and late sowing periods.

Productivity parameters of studied varieties and samples under optimal sowing period varied over the years under the influence of weather. It was found that in 2012, the yield was 20,.6-74,3 c/ ha in optimal sowing period, in 2013 this figure was 31,0-87,1 c/ha, and in 2014 the yield of varieties and samples constituted 29,8-79,5 c/ha. According to the three year observation results, the standard Krasnodar-99 variety’s productivity was 59,8 c/ha, however the yield of KR11-105-43, Gozgon, KR11-105-44, Jayhun, Bunyodkor, Faravon, H. Bashir, Turkiston, KR11-105-50, Dostlik, KR11-105-50, Navruz varieties and samples was found to be higher than the standard variety, and also was found that the high yield could be achieved when they were sown in late period.

Table 1: Productivity of varieties and samples and the weight of 1000 grains (Karshi, 2012-2014).

№	Variety	Optimal period				Late period			
		Productivity/ yield, c/ha		Weight of 1000 grains, gr		Productivity/ yield, c/ha		Weight of 1000 grains, gr	
		Average	Difference compared to standard, c/ha	Average	Difference compared to standard, c/ha	Average	Difference compared to standard, c/ha	Average	Difference compared to standard, c/ha
1	Matonat	55,8±5,7	-4	40,6±2,3	1,93	47,1±14,0	7,1	39,9±1,3	6,27
2	KR11-105-11	68,0±6,3	8,2	44,5±3,7	5,89	58,8±11,1	18,8	39,7±1,5	6,07
3	Turkiston	72,2±10,0	12,4	41,9±1,2	3,26	56,9±11,0	16,9	37,0±5,3	3,35
4	Yujnaya-12	56,8±6,2	-3	43,4±1,7	4,77	49,4±16,7	9,4	38,6±3,2	4,98
5	Navruz	68,2±8,9	8,4	40,7±2,5	2,03	53,5±13,7	13,5	39,9±0,8	6,26
6	KR11-105-42	62,8±11,9	3	44,3±2,9	5,66	52,6±3,6	12,6	36,6±4,4	3,02
7	KR11-105-43	79,6±5,4	19,8	45,5±1,9	6,88	63,9±0,5	23,9	41,2±0,6	7,56
8	KR11-105-44	64,9±7,4	5,1	44,6±4,4	5,9	52,0±3,6	12	38,6±1,7	4,99
9	KR11-105-45	60,3±0,6	0,5	44,3±1,8	5,62	50,2±13,3	10,2	37,7±4,0	4,07

10	KR11-105-50	68,0±14,5	8,2	40,5±3,2	1,86	53,7±3,9	13,7	39,3±3,5	5,68
11	KR11-105-59	61,6±9,7	1,8	41,3±1,8	2,62	50,3±7,9	10,3	37,3±3,0	3,74
12	H. Bashir	72,6±8,9	12,8	41,3±1,7	2,62	57,4±6,4	17,4	40,1±1,0	6,53
13	Zarrin	73,3±10,8	13,5	43,2±0,2	4,5	58,7±5,4	18,7	39,9±0,0	6,29
14	Gozgon	75,1±10,0	15,3	44,3±0,5	5,64	61,9±4,9	21,9	40,7±0,7	7,06
15	KR11-105-90	59,1±7,3	-0,7	39,1±2,5	0,43	51,0±6,7	11	35,1±2,6	1,46
16	KR11-105-96	57,7±7,4	-2,1	41,3±2,9	2,69	50,7±6,8	10,7	34,5±1,0	0,86
17	Bunyodkor	74,1±8,6	14,3	45,5±2,2	6,79	59,5±6,3	19,5	42,2±0,8	8,58
18	Farovon	74,0±9,8	14,2	40,7±1,0	2,08	56,1±5,0	16,1	40,2±1,0	6,61
19	Barhayot	71,5±10,5	11,7	45,5±2,4	6,87	58,2±4,5	18,2	40,6±1,3	7,01
20	Krasnodar-99	59,8±6,8	0	38,7±2,0	0	40,0±3,3	0	33,6±1,9	0

Furthermore, the correlation between the studied varieties and samples in the experiment of optimal period and other indicators was studied. It was determined that there was a positive correlation between the productivity and gluten content (r = 0.08), grain hardness (r = 0.14), IDC index (r = 0.06), grains in a spikelet (r = 0.27), number of spikelets in a spike (r=0.35), plant height (r = 0.23), last node length (r = 0.19), protein content (r = 0.26), spike length (r = 0.28), weight of 1000 grains (r = 0.03), weight of a spike's grain (r = 0.10), spikes weight (r = 0.30), and in late period there was correlation between the productivity of variety and samples and weight of 1000 grains (r = 0.28).A positive correlation was found between the yield of the variety and samples and the spike length (r = 0.41), between the yield and the number of grains of a spike (r = 0.27), between the yield and the weight of the spikes (r = 0.16), between the yield and the weight of grains of main spike (r = 0.19). It was also determined by the results of experiments that higher yields would also increase grain quality. A study of the correlation of yield with grain quality indicators revealed a positive correlation between protein content in grain (r = 0.17), gluten content (r = 0.07), and grain hardness (r = 0.41).

The weight of 1000 grains. The weight of 1000 grains of wheat varieties is important for high productivity and grain quality. External environmental factors, especially during the period of grain filling, have a significant impact on 1000 grains. In particular, the effects of heat destroy the physiological processes, after which the grain becomes empty. In result, the weight of 1000 grains reduced.

The weight of 1000 grains is an indicator that defines the size and completeness of grain. As a result of our experience we noted that it is particularly important to select varieties and samples with higher weight of 1000 grains for optimal and late periods.

It was observed on the base of three year results that the weight of 1000 grains of studied varieties and samples varied depending on environmental factors. During the optimal and late periods, the samples with higher weight of 1000 grainswere selected for breeding. The weight of 1000 grains of studied varieties and samples sown in 2012 in optimal period decreased by 32,14-52,01 g, while in the late sowing season by 25,5-43,7 g or 6,6-8,3 g less compared to the optimal sowing time.

The same tendency continued in 2013-2014. Based on the results of 3 year experience, the weight of 1000 grains of varieties and samples was found to be 32,15-46,16 gwhen planted in optimal time, and 28,6-42,1 g for late sowing, or the difference between the weight of 1000 grains of varieties and samples varied from3,5 to 4,0 grams.

Pamyat-47, Farovon, H-147, KR11-105-44, KR11-105-43, Gozgon, KR11-105-50, H.Bashir, Bunyodkor, Navruz, KR11-105-11 varieties and samples with higher weight of 1000 grains were selected and recommended for the crossbreeding in creating heat-resistant varieties.

Protein content andgluten parameters. The amount of protein in wheat cereals depends on the properties of baking and plays an important role in the production of high-quality and nutritious bakery products. The high protein content of wheat depends on the genetic characteristics of the plant and may vary depending on environmental factors.

Table 2: Productivity of varieties and samples and the weight of 1000 grains (Karshi, 2012-2014)

№	variety	Optimal time			Late period		
		Protein content, %	Gluten amount, %	Hardness of grain	Protein content, %	Gluten amount, %	Hardness of grain
1	Matonat	13,9±0,9	25,7±2,5	44,8±15,7	12,6±0,9	24,3±0,8	43,6±9,4
2	KR11-105-11	15,5±1,3	30,4±2,7	58,0±3,0	14,2±0,2	28,3±0,3	59,3±7,5
3	Turkiston	15,6±0,8	30,6±1,2	62,9±3,0	14,2±0,1	28,5±0,1	62,2±2,5
4	Yujnaya-12	16,2±0,7	29,2±3,0	53,1±3,1	13,9±0,4	24,2±1,6	56,6±14,3
5	Navruz	14,9±0,6	30,6±0,7	58,2±8,8	14,2±0,3	27,9±1,5	57,5±6,9
6	KR11-105-42	14,7±0,8	26,7±2,8	58,8±16,8	13,5±0,3	25,1±2,5	58,5±18,8
7	KR11-105-43	15,6±0,7	30,5±0,8	72,3±4,5	14,5±0,2	28,9±0,5	66,4±4,9
8	KR11-105-44	15,1±2,3	27,5±0,6	56,7±6,7	14,2±0,1	26,0±3,1	50,3±13,9
9	KR11-105-45	13,3±0,5	27,0±1,0	51,0±7,9	12,4±0,4	25,8±0,3	41,4±6,5
10	KR11-105-50	14,5±1,3	29,6±0,8	56,8±14,2	14,0±0,1	27,0±1,7	57,1±8,9
11	KR11-105-59	14,0±0,2	28,6±1,5	53,2±6,4	12,9±0,3	26,1±2,6	47,3±10,5
12	H. Bashir	15,4±0,5	29,7±0,8	62,3±11,1	14,4±0,2	28,5±0,3	63,2±3,8
13	Zarrin	15,1±1,3	29,3±1,1	62,2±4,7	14,3±0,2	28,2±0,4	61,1±3,3
14	Gozgon	15,4±0,9	29,6±0,5	63,2±13,1	14,3±0,2	28,2±0,2	66,5±5,0
15	KR11-105-90	15,1±0,4	28,5±0,9	60,7±7,9	12,2±1,1	23,7±1,6	38,3±10,0
1	KR11-105-	13,6±0,	27,6±1,6	52,1±4,3	12,7±0,	25,5±0,5	50,1±15,3

6	96	8			7		
17	Bunyodkor	16,0±0,6	29,8±0,9	69,6±4,8	14,5±0,4	28,4±0,3	63,3±6,6
18	Farovon	15,2±1,0	29,4±0,5	66,2±3,3	14,2±0,2	28,5±0,1	63,5±6,8
19	Barhayot	15,1±0,9	28,7±0,3	66,9±4,8	14,3±0,4	28,4±0,1	61,9±4,2
20	Krasnodar-99	14,0±1,1	28,0±0,4	54,8±8,4	13,1±0,2	26,3±0,9	47,2±15,3

It was observed that the protein content of studied varieties and samples sown in optimal and late periods was slightly lower in the late period than in the optimal period. This is because of the intense heat that occurs during the grain filling. During the late sowing period, grain filling phase was in severe heat conditions. At the same time, there was significant decrease in protein content of most

Table 3: Varieties and samples selected by heat-resistance feature (Karshi, 2012)

№	Variety	Optimal period							Late period						
		Spiking date	Maturation date	Spiking-maturation stage	The sum of temperature at spiking maturation stage	Average temperature for one day	productivity, c/ha	Weight of 1000 grains, gr	Spiking date	Maturation date	Spiking-maturation stage	The sum of temperature at spiking maturation stage	Average temperature for one day	productivity, c/ha	Weight of 1000 grains, gr
1	Matonat	April 21	June 5	45	1059.5	23.5	68.6	44.54	May 2	June 8	37	918.3	24.8	33.8	41.48
2	KR11-105-11	April 19	June 6	48	1132.5	23.6	51.8	48.17	April 30	June 9	40	978.8	24.5	31.2	35.44
3	Turkiston	April 28	June 5	38	918	24.2	41	40.53	May 4	June 13	40	1006	25.2	32.7	35.42
4	Yujnaya-12	April 24	June 5	42	997.5	23.8	51.5	44.98	May 6	June 15	40	1035.3	25.9	27.1	34.39
5	Navruz	April 21	June 3	43	1006	23.4	63.9	42.42	May 2	June 11	40	1019.5	25.5	31.6	40.61
6	KR11-105-42	April 23	June 7	45	1071.5	23.8	52.7	46.57	May 6	June 14	39	1005.7	25.8	31.9	41.85
7	KR11-105-43	April 21	June 4	44	1033.5	23.5	73.6	47.68	April 30	June 11	42	1054.7	25.1	61	41.62
8	KR11-105-44	April 20	June 5	46	1083	23.5	54.3	48.53	April 30	June 11	42	1049.8	25	33.8	38.95
9	KR11-105-45	April 16	June 5	50	1173	23.5	61.2	44.14	April 28	June 8	41	1006.2	24.5	41.2	41.54
10	KR11-105-50	April 25	June 6	42	1003.5	23.9	47.7	39.48	May 2	June 10	39	982	25.2	43.5	43.03
11	KR11-105-59	April 24	June 4	41	971.5	23.7	53.8	40.75	May 3	June 10	38	974.3	25.6	26.5	34.58
12	H. Bashir	April 20	June 53	44	1029.5	23.4	57.7	39.19	April 30	June 9	40	1009.2	25.2	36.9	34.72

13	Zarrin	April 23	June 52	40	936.5	23.4	60.8	43.34	May 3	June 11	39	1006.5	25.8	31.4	36.46
14	Gozgon	April 24	June 54	41	971.5	23.7	67.3	43.77	May 6	June 13	38	975.8	25.7	34.3	36.11
15	KR11-105-90	April 20	June 53	44	1029.5	23.4	61.3	40.09	May 1	June 10	40	986.8	24.7	46.9	33.37
16	KR11-105-96	April 24	June 5	42	997.5	23.8	56.7	43.66	May 4	June 15	42	1080.8	25.7	32.1	33.75
17	Bunyodkor	April 22	June 6	45	1065.5	23.7	68.9	47.29	May 3	June 10	38	961	25.3	40.9	38.16
18	Farovon	April 24	June 6	43	1024.5	23.8	65.3	39.46	May 7	June 11	35	907.5	25.9	35.4	34.26
19	Barhayot	April 21	June 6	46	1086.5	23.6	62.3	47.9	May 1	June 6	36	891	24.8	37.8	25.88
20	Krasnodar-99	April 27	June 6	40	964	24.1	51.2	40.9	May 6	June14	39	1012.2	26	30	31.74
	LSD_{05}, c/ha						2.6							2.0	
	Cv, %						5.0							4.7	

Table 4: Varieties and samples selected by heat-resistance feature (Karshi, 2013)

Entry	variety	Optimal period							Late period						
		Spiking date	Maturation date	Spiking maturation stage days	The sum of temperatures at spiking-maturation stage	Average temperature for one day	Productivity, c/ha	Weight of 1000 grains, g	Spiking date	Maturation date	Spiking maturation stage days	The sum of temperatures at spiking-maturation stage	Average temperature for one day	Productivity, c/ha	Weight of 1000 grains, g
1	Matonat	April 14	June 5	52	1125	21.6	67.6	45	April 22	June 5	44	993	22.6	73.8	39.63
2	KR11-105-11	April 18	June 5	48	1064.5	22.2	79.4	40.87	April 20	June 6	47	1059	22.5	73.3	39.1
3	Turkiston	April 20	June 4	45	1002.5	22.3	71	39.57	April 23	June 4	42	940.5	22.4	45.3	39.83
4	Yujnaya-12	April 22	June 5	44	993	22.6	49.2	42.73	April 30	June 9	40	986.5	24.7	68	41.67
5	Navruz	April 15	June 2	48	1017	21.2	80	40.87	April 20	June 4	45	1002.5	22.3	79.6	40.87
6	KR11-105-42	April 15	June 4	50	1075.5	21.5	79.1	45.7	April 22	June 4	43	963.5	22.4	74.8	36.53

7	KR11-105-43	April 13	June 6	54	1174	21.7	79.1	43.17	April 17	June 6	50	1107	22.1	66.3	39.73
8	KR11-105-44	April 14	June 7	54	1180.5	21.9	69.9	45.5	April 19	June 7	49	1104	22.5	68.6	40.07
9	KR11-105-45	April 10	June 4	55	1185.5	21.6	50.1	41.93	April 14	June 4	51	1095.5	21.5	83	38.83
10	KR11-105-50	April 18	June 5	48	1064.5	22.2	74.1	40.87	April 22	June 5	44	993	22.6	56.8	38.57
11	KR11-105-59	April 15	June 2	48	1017	21.2	81.1	37.73	April 20	June 4	45	1002.5	22.3	69.9	39.2
12	H. Bashir	April 12	31.май	49	1024	20.9	79.9	38.43	April 18	June 4	46	1005	21.8	64.2	38.27
13	Zarrin	April 16	June 3	48	1034.5	21.6	87	37.93	April 22	June 4	45	1020	22.7	78.5	36.93
14	Gozgon	April 17	June 2	46	992	21.6	82.2	41.43	April 23	June 4	42	940.5	22.4	63.4	35.37
15	KR11-105-90	April 14	June 4	51	1095.5	21.5	68.9	39.4	April 20	June 3	44	972.5	22.1	73.9	38.17
16	KR11-105-96	April 18	June 6	49	1091.5	22.3	65.8	40.47	April 23	June 4	42	940.5	22.4	77	33.9
17	Bunyodkor	April 18	June 4	47	1035	22	75.5	43.6	April 21	June 5	45	1014	22.5	70.9	44.4
18	Farovon	April 18	June 4	47	1035	22	96.9	39.53	April 24	June 3	40	895	22.4	71	42.9
19	Barhayot	April 15	June 3	49	1045.5	21.3	69.5	44.23	April 20	June 9	50	1147.5	23	67.1	38.17
20	Krasnodar-99	April 21	June 5	45	1014	22.5	67.1	36.23	April 24	June 9	46	1070	23.3	49.6	35.5
	LSD_{05}, c/ha						1.8							1.8	
	Cv, %						2.3							2.9	

Table 5: Heat resistance of varieties and samples (Karshi, 2014)

№	Variety	Optimal period							Late period						
		Spiking date	Maturation date	Spiking-maturation stage, days	The sum of temperature at spiking maturation stage	Average temperature per day	Productivity, c/ha	Weight of 1000 grains, g	Spiking date	Maturation date	Spiking-maturation stage, days	The sum of temperature at spiking maturation stage	Average temperature per day	Productivity, c/ha	Weight of 1000 grains, g
1	Matonat	April 19	June 6	48	1152.5	24	48.4	34.1	April 29	June 9	41	1041.5	25.4	39.1	42.5
2	KR11-105-11	April 20	June 2	43	1036	24.1	55.3	37.17	April 26	June 8	43	1072.5	24.9	51.4	37.8
3	Turkiston	April 22	June 4	43	1042.5	24.2	68	42.4	May 1	June 6	36	912.5	25.3	50.2	30.57
4	Yujnaya-12	April 23	June 3	41	999	24.4	71.3	37.13	April 23	June 8	46	1126.5	24.5	61.9	40.57

5	Navruz	April 20	May 30	40	964.5	24.1	56.5	34.67	May 2	June 6	35	886.5	25.3	62.9	39.43
6	KR11-105-42	April 25	June 3	39	962.5	24.7	67.5	36.53	May 4	June 6	33	832	25.2	50	36.23
7	KR11-105-43	April 20	June 6	47	1133	24.1	68.1	36.47	April 28	June 8	41	1032.5	25.2	62.3	37.47
8	KR11-105-44	April 22	June 3	42	1020	24.3	67.2	35	April 29	June 9	41	1041.5	25.4	54.3	37.77
9	KR11-105-45	April 20	June 8	49	1186.5	24.2	60.6	42.23	April 30	June 9	40	1019	25.5	39.4	33.47
10	KR11-105-50	April 23	June 5	43	1047.5	24.4	73.7	33.43	May 2	June 10	39	996	25.5	56	35.93
11	KR11-105-59	April 22	May 30	38	925.5	24.4	65.7	32.47	April 29	June 7	39	987	25.3	54.7	41.23
12	H. Bashir	April 20	June 3	44	1059	24.1	59.7	30.7	May 1	June 7	37	939	25.4	42.8	28.7
13	Zarrin	April 23	June 2	40	976	24.4	73.4	30.87	April 29	June 7	39	987	25.3	64	34.93
14	Gozgon	April 22	June 2	41	997	24.3	72.6	31	May 2	June 6	35	886.5	25.3	60.6	32.83
15	KR11-105-90	April 19	June 2	44	1055.5	24	46.6	31.83	April 26	June 6	41	1019	24.9	67	33.3
16	KR11-105-96	April 24	June 4	41	1001	24.4	53.1	33.37	April 30	June 10	41	1047.5	25.5	49.4	35.73
17	Bunyodkor	April 23	June 2	40	976	24.4	54.8	35.97	May 2	June 6	35	886.5	25.3	48	41.33
18	Farovon	April 24	June 1	38	932	24.5	71.8	32.1	May 4	June 8	35	885.5	25.3	43.1	37.73
19	Barhayot	April 19	June 4	46	1101	23.9	55.3	39.57	April 27	June 8	42	1048.5	25	52.9	43.23
20	Krasnodar-99	April 25	June 5	41	1011	24.7	69.4	35.57	May 1	June 10	40	1022	25.6	42.8	31.13
	LSD_{05}, c/ha						2.0							1.2	
	Cv, %						3.5							3.1	

cereals, while in heat-resistant varieties this case was not noted. Varieties and samples with high protein content were determined and selected for optimal and late sowing times. The protein content of varieties and samples varied over the years depending on environmental factors. According to the results of 3 year experiment, varieties and lines with high and similar protein content were identified. Protein content of varieties and samples studied in the optimal period in 2012 constituted 11,7-7,0%, in the late sowing period 11,7-14,9%, in 2013 these figures were 12,7-18,8%, and 11,6 -14,4% respectively, in 2014 - 12,0-16,4%, and 9,9-14,7%. In both periods, heat-resistant varieties with high protein content were selected.

Baking properties of wheat flour are largely assessed by the amount and quality of gluten. The amount and quality of gluten is understood as the hydrated gel-resin mass, consisting of a water-washed-out wheat dough from insoluble protein. Gluten can be of light, gray and black color. However, only light gluten has the best elasticity feature. The fact that gluten is in gray and black color indicates the effects of environmental conditions and other disorders during grain maturation. Specific parameters of wheat, its hardness, gluten amount and quality can define somehow technological value of wheat and the possibility of baking best quality bread from the wheat.

The highest levels of gluten were observed in both sowing periods of experiment conducted in 2013. The amount of gluten in the varieties and samples varied over the years, depending on the weather conditions. In most varieties and samples the amount of gluten significantly decreased due to the heat effects during the spiking maturation period, while in some varieties it was noted to be normal. According to experiment results, the amount of gluten in optimal sowing period in 2012 constituted 23,2-33,0 % while in late period 23,0-29,2 %, in 2013 it was 23,2-33,8 % in optimal period, and 19,5-29,9 % in late period, in 2014 these indicators were 20,5-31,4 % and 21,1-29,1% respectively, in accordance with three year results, average amount of gluten made 24,5-30,7 % for optimal time, for late period it was 23,2-28,9 %. The varieties and samples with high amount of protein and gluten content were selected over the years. For example, in the varieties and samples, such as KR11-105-44, H.Bashir, Bunyodkor, Gozgon, KR11-105-43, KR11-105-50 , KR11-105-90, KR11-105-42, KR11-105-11, KR11-105-50, Navruz the amount of gluten didn't decrease and their quality parameters were found to be the highest.

Conclusion

To conclude it can be said that the longer and later the spiking and maturation period is, the more flowering and grain filling phase of the varieties and samples remain under intense heat. According to experiment results, several varieties and samples were highly evaluated by all parameters. In the experimental varieties and samples under late sowing period, the spiking stage began 9-10 later compared to the optimal sowing and the yield decreased by 15,3– 27,6 c/ha, weight of 1000 grains decreased by 0,25-9,85 gr due to the rise in temperature during “spiking-maturation” stage. Specifically, in the varieties and samples that are non-resistant to heat, there was a sharp decline in productivity, weight of 1000 grains, and other yields. Among the varieties and samples studied by sowing in optimal and late periods, KR11-105-43 (Shams) variety gave 19,8 c/ha yield more in optimal period and in late period 23,9 c/ ha, KR11-105-44 variety in the optimal period 14,3 c/ha, in the late period 19,5 c/ha, KR11-105-50 (Kesh-2016) in the optimal time 14,2 c/ha, in late period 16,1 c/ha, Bunyodkor variety– 13,5 c/ha in optimal period while in late period its yield was 18,7 c/ha more compared to standard Krasnodar-99 yield and they were found to be resistant varieties to heat.

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