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# Results Of Selection Research On Developing New, High-Yielding Varieties And Lines Of Bread Wheat Adapted To Climate Changes For Rainfed Lands

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**ABSTRACT.** As a result of global climate change, Uzbekistan is observing an increase in air temperature, a decrease in precipitation levels, uneven distribution of rainfall during the plant vegetation period, and a reduction in the number of snowy days in winter. On rainfed lands, a significant difference in the heading phase was observed among wheat variety samples, new varieties, and lines. Although early heading in the studied varieties indicates early maturity, it was found that this leads to lower yields compared to late-maturing varieties. However, some early-heading varieties were observed to have high grain yields. New varieties of Bread Wheat, such as KSI-96/2024/Sp-1/447/2021 (Tagob), KSI-97/2024/Sp-1/834/2021 (Zartepa), and the line Sp-1/382/2021 (earlyripe), were found to have higher grain yields compared to the early-ripening standard variety, despite heading earlier than this variety. Furthermore, during the studies, it was determined that a higher number of grains per spike and a greater weight of 1000 grains contribute more significantly to increased yield compared to other productivity elements.
**KEY WORDS.** Bread Wheat, rainfed lands, climate change, growing period, variety, line, heat and drought, early ripening, resistance to stress factors, spike length, number of grains per spike, grain weight, 1000 s cernel weight, yield.

**INTRODUCTION.** In Central Asia, including Uzbekistan, Bread wheat (Triticum aestivum L.) is the primary cereal crop cultivated on rainfed lands. The average grain yield varies between 0.5 and 1.8 tons per hectare, depending on weather conditions. Soil moisture deficiency is considered one of the main factors affecting crop productivity on rainfed lands.

Rising temperatures, heat waves, and a decrease in annual precipitation are all manifestations of climate change (CC) that significantly impact the yield of Bread wheat. Temperature is the primary driving force behind the phenological development of plants, and these changes also affect wheat phenology, which can influence grain quality and the accumulation of gluten proteins [5].

Climate change (CC) is severely hampering the productivity of Bread wheat, while the intensification of extreme weather events and abiotic stresses (drought and abnormal heat) threatens food security, leading to increased losses in agricultural production [1]. In general, it is estimated that an increase in average temperature by 2.0 °C could lead to a reduction in cereal grain production by more than 20-40% [2].

According to data from the Hydrometeorological Center of the Republic of Uzbekistan, in recent years there has been an increase in the average long-term temperature by +1.5 to +1.8°C, frequent changes in atmospheric pressure, and the melting of 25% or more of mountain glaciers. Under the influence of global climate change, Uzbekistan is experiencing a rise in air temperature, a decrease in precipitation levels, uneven distribution of rainfall during the vegetation period of plants, and a reduction in the number of snowy days during winter.

Furthermore, stress factors such as dry and warm winters, the abrupt transition from shortened spring days to hot summer months, drought, and intense heat are having a strong negative impact on the yield and quality of wheat grain in rainfed lands. In particular, the rise in air temperature to +33-38°C during the grain filling phase of wheat is resulting in low grain yields [3].

In hot and dry conditions, the accumulation of dry matter in wheat plants slows down and grain quality deteriorates. High temperatures affect the plant's reproductive organs, leading to incomplete fertilization during flowering. If this occurs during the grain-filling period, the grains become underdeveloped and hollow, resulting in a decrease in yield due to the reduced weight of 1000 grains [4].

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The genetic characteristics of plants play a crucial role in yield, which is influenced not only by soil and climatic conditions and agronomic measures but also by pathological and entomological factors.

Grain yield depends on the number of productive ears per unit area, the number of grains per ear, and the weight of 1000 grains. These indicators, which determine productivity, change depending on environmental conditions and lead to high or low grain yields.

In wheat plants, the number of grains per spike is important for high yields, this trait is a hereditary trait of the variety and manifests itself in part depending on the growing conditions. In studies conducted on rainfed lands, it was observed that under the influence of drought, the number of grains per spike changed less than other productivity elements, and this indicator remained the same over the years. Therefore, in the selection of intensive Bread wheat varieties for rainfed areas in Uzbekistan, the selection of samples and lines based on the high number of grains in the spike is effective.

**MATERIALS AND METHODS.** The rainfed fields of the Research Institute of Rainfed Agriculture belong to the hilly region and are located at an altitude of 580 meters above sea level. In most years, starting from the second half of May, the amount of precipitation decreases, and a lack of moisture in the soil begins to be felt. This situation corresponds to the spiking and flowering periods, which are considered the most crucial developmental phases of winter grain crops. From this time, as a result of a sharp decrease in soil moisture due to transpiration and physical evaporation, and an increase in air temperature, the processes of photosynthesis in plants slow down, and in some cases, completely stop. As a result, the grain in the spikes becomes small and hollow, and the yield decreases.

At the Research Institute of Rainfed Agriculture, in 2024, scientific research was conducted on the developing of high-yielding varieties of Bread wheat adapted to climate change, with high grain quality and bread quality for rainfed lands. Field experiments were conducted in the field of the institute's central experimental farm.

For the purpose of conducting scientific research, 36 local varieties, new varieties and lines. All agrotechnical measures were carried out on the basis of recommendations and methods developed by the Gallaaral branch of RIGLCIL in 1994, phenological observations, assessments of various indicators in field and laboratory conditions, analyses based on methodological manuals developed by the State Commission for Variety Testing of Agricultural Crops (1997) and the All-Union Institute of Plant Industry (VIR,1984) [6].

**RESEARCH RESULTS AND DISCUSSIONS.** The influence of weather conditions in 2023-2024, during which scientific research was conducted, on field experiments was studied. This year, the amount of precipitation was 39.9 mm (322.1 mm) less than the long-term amount (361.9 mm).

For conducting research, field experiments were planted in the third ten days of October 2023, and full germination was scheduled for December 22. In October, there was no precipitation, in November - 45.2 mm, and in December - 17.0 mm (the long-term amount was 17.1 mm, 35.0 mm, and 55.0 mm, respectively), and sufficient moisture was accumulated in the soil for germination.

The higher precipitation levels during these months compared to long-term averages resulted in sufficient soil moisture in spring, positively affecting plant growth and development. However, a sudden temperature increase at the end of the grain filling and wax ripening phase led to partial heat damage in wheat varieties, causing incomplete grain filling and a reduction in the weight of 1000 grains.

Seasonal changes in the amount of precipitation under the influence of global climate change in recent years, that is, the incorrect distribution of precipitation during the plant's growing season, despite sufficient soil moisture during the critical period of the growing season, an increase in air temperature negatively affected the growth and development of wheat compared to years with favorable weather conditions.

The difference in the amount of precipitation during the growing season of plants had a different influence on the growth and development of wheat seedlings. The amount of precipitation in March was 87.2 mm (average perennial 65.0 mm), in April, the most critical period of the seedling growth period, it was 32.0 mm (average perennial 53.6 mm), in May - 67.5 mm (average perennial 35.4 mm).

During research on developing new varieties and lines of Bread wheat adapted to climate change for rainfed lands, local varieties, new varieties, and lines were studied in the Competition Variety Testing (CVT) nursery for their valuable economic traits and characteristics. The study examined important economic and biological traits of new varieties and lines, including phenological phases, plant height, spike length, number

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of spikelets per spike, number of grains per spike, weight of grains per spike, 1000 s of kernel weight, and grain yield. Based on these characteristics, new varieties and lines adapted to climate change were evaluated.

During the studies, when determining the early maturity of varieties and lines, the heading phase was identified as the main characteristic of plants. In the CVT nursery, it was established that the heading phase in the variety samples, new varieties, and lines differed significantly from each other, i.e., by 28 days.

Accordingly, in the Tezpishar variety, which was taken as the standard, the full heading date was observed on 01.05.2024. The heading phase of the Erythrospermum-2021 line was recorded on 17.04., and 14 days earlier than the standard variety. For new varieties such as KSI-96/2024/Sp-1/447/2021 (Tagob) and KSI-97/2024/Sp-1/834/2021 (Zartepa), this indicator corresponded to 28.04 and 30.04 respectively. The Sp-1/382/2021 (earlyripe) line reached this phase on 29.04. It was determined that these varieties headed 2-4 days earlier than the standard variety. In addition, the data in the table show that varieties and lines Sp-1/744/2021, Sp-1/602/2021 equaled the standard variety or germinated 1-2 days later, varieties and lines KSI-2020/16 kp-2016/58, Bakhmal-97, Grekum-2023, Sp-1/835/2021, Sp-1/835/2021, PSI-2020/14 germinated 12-13 days later (table).

In Bread wheat varieties grown on rainfed lands, the indicator of plant height is important, and the selection of new tall varieties and lines on rainfed lands is one of the breeding directions.

Favorable weather conditions and sufficient soil moisture during the growing season led to normal plant growth. For example, if the plant height in the Tezpishar variety was 105 cm, then in the varieties and lines KSI-97/2024/Sp-1/834/2021 (Zartepa), Sp-1-907/2021 (sogood), Sp-1/835/2021, KSI-96/2024/Sp-1/447/2021 (Tagob) it was 125 cm, 123 cm, 121 cm, 113 cm, respectively.

In wheat plants, the number of grains per spike is important for high yields, and this trait develops depending on the hereditary characteristics of the variety and partially on the growing conditions. In some studies, conducted on rainfed lands, it was noted that under the influence of drought, the number of grains per spike changed less than other productivity elements, and this indicator remained the same over the years. Therefore, in the selection of intensive Bread wheat varieties for rainfed areas of Uzbekistan, the selection of samples and lines based on the high number of grains in the ear is effective.

Lines were identified in the CVT nursery according to productivity indicators. The “Tezpishar” (standard) variety showed the following characteristics: spike length of 10.1 cm, number of spikelets per spike of 16.6, number of grains per spike of 32.6, and grain weight per spike of 1.06 g.

Biometric analysis results revealed that the Sp-1/744/2021 line had a spike length of 12.6 cm, 17.0 spikelets per spike, 40.2 grains per spike, and a grain weight of 1.4 g per spike. The new variety KSI-96/2024/Sp-1/447/2021 (Tagob) demonstrated a spike length of 12.1 cm, 19 spikelets per spike, 45.8 grains per spike, and a grain weight of 2.0 g per spike. In addition, high indicators for this trait were also observed in the new varieties and lines Sp-1/835/2021, Sp-1/602/2021, and KSI-97/2024/Sp-1/834/2021 (Zartepa), with respective spike lengths of 11.7 cm, 11.7 cm, and 11.2 cm; number of spikelets per spike at 19.0, 17.3, and 18.2; number of grains per spike at 53.0, 51.3, and 48.6; and grain weight per spike at 2.1 g, 2.3 g, and 2.1 g. These indicators demonstrated superiority over the standard variety.

The cooler weather conditions during the wheat grain filling period in 2024 resulted in high 1000s of kernel weight indicators in the variety samples.

When analyzing the weight of 1000 grains in the lines studied in the RNS, it was found that the Tezpishar (standard) variety weighed 32.5 g, while the new KSI-96/2024/Sp-1/447/2021 (Tagob) variety weighed 45.9 g, the Sp-1/602/2021 line weighed 45.5 g, the KP-26/2020 and Sp-1-907/2021 (so good) lines weighed 43.5 g, and the new KSI-97/2024/Sp-1/834/2021 (Zartepa) variety weighed 43.2 g, all showing higher values compared to the standard variety.

Analysis of the competitive variety testing nursery revealed that samples with high productivity indicators also demonstrated high grain yields.

While the grain yield of the Tezpishar (standard) variety was 1.54 t/ha, the KP-26/2020 line yielded 2.85 t/ha, the KSI-10/2023 line yielded 2.58 t/ha, the new Grekum-2023 variety yielded 2.56 t/ha, and the Sp-1/602/2021 line yielded 2.38 t/ha. New varieties and lines with grain yields higher than the standard variety were identified. In the early-ripening lines Eritrospermum-2021, Sp-1/382/2021 (earlyripe), the yield was lower than in other varieties and lines and amounted to 1.4 t/ha and 15.5 t/ha, respectively. The late-ripening

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variety Bakhmal-97 had the lowest yield of 1.31 t/ha due to its intolerance to heat and drought. As a result of the research, it was once again proven that early-ripening varieties have a low grain yield.

**Productivity indicators of Bread wheat varieties and lines in a Competitive Variety Testing nursery (Gallaaral, 2024).**

| № | Name | Plant height см | Main spike | | | | 1000 kernel weight, g | Heading date | Yield, t/ha |
|---|---|---|---|---|---|---|---|---|---|
| | | | Spike length, cm | Spikelets on the spike, pc | Ggrans on the spike, pc. | Grain weight on the spike, g | | | |
| 1 | Tezpishar (an.) | 105 | 9,4 | 16,6 | 32,6 | 1,06 | 32,5 | 1.05. | 1,54 |
| 2 | Baxmal-97 | 116 | 9,5 | 15,0 | 26,3 | 1,0 | 37,8 | 13.05. | 1,31 |
| 3 | Sogdiyona | 92 | 9,5 | 16,2 | 31,0 | 1,2 | 38,7 | 10.05. | 1,90 |
| 4 | Kizildon | 101 | 9,5 | 17,4 | 38,2 | 1,4 | 36,6 | 7.05. | 2,02 |
| 5 | Nushkent | 110 | 10,3 | 16,6 | 34,4 | 1,5 | 43,6 | 5.05. | 1,88 |
| 6 | Grekum-2023 | 108 | 9,5 | 18,2 | 32,8 | 1,2 | 35,4 | 12.05. | 2,56 |
| 7 | KSI-96/2024/Sp-1/447/2021 (Tagob) | 113 | 12,1 | 19 | 45,8 | 2,00 | 45,9 | 28.04. | 2,02 |
| 8 | KSI-97/2024/Sp-1/834/2021 (Zartepa) | 125 | 11,2 | 18,2 | 48,6 | 2,1 | 43,2 | 30.04. | 2,08 |
| 9 | Sp-1/744/2021. | 109 | 12,6 | 17,0 | 40,2 | 1,4 | 34,8 | 2.05. | 1,77 |
| 10 | Sp-1/602/2021 | 104 | 11,7 | 17,3 | 51,3 | 2,3 | 45,5 | 2.05. | 2,38 |
| 11 | KSI-2020/16 kp-2016/58 | 112 | 8,4 | 16,2 | 29,0 | 1,1 | 36,6 | 10.05. | 2,27 |
| 12 | KSI-10/2023 | 110 | 9,7 | 16,6 | 42,8 | 1,66 | 38,8 | 12.05. | 2,58 |
| 13 | PSI-2020/9 | 107 | 10,0 | 18,8 | 41,4 | 1,6 | 39,6 | 12.05. | 1,96 |
| 14 | KP-26/2020 | 101 | 11 | 19 | 47 | 2,0 | 43,5 | 11.05. | 2,85 |
| 15 | KSI-17/2023 | 102 | 10,0 | 16,7 | 33,7 | 1,0 | 29,7 | 7.05. | 2,15 |
| 16 | Sp-1/835/2021 | 121 | 11,7 | 19,0 | 53,0 | 2,1 | 40,3 | 13.05. | 1,90 |
| 17 | KP 2021/82-(SemxOqbug‘) | 97 | 8,8 | 17,8 | 34,8 | 1,3 | 37,4 | 2.05. | 2,34 |
| 18 | Eritrospermum-2021 | 100 | 7,9 | 14,3 | 26,0 | 1,1 | 40,4 | 17.04. | 140 |
| 19 | Sp-1-907/2021 (sogood) | 123 | 10,8 | 18,8 | 38,2 | 1,7 | 43,5 | 12.05. | 2,09 |
| 20 | Sp-1/382/2021 (earlyripe) | 100 | 10,5 | 17,0 | 35,0 | 1,1 | 31,4 | 29.04. | 1,55 |
| 21 | PSI-2020/14 | 115 | 9,0 | 11,7 | 28,3 | 1,1 | 37,7 | 13.05. | 2,17 |
| | **$LDS_{05}$** | | | | | | | | **0,38** |
| | **P %** | | | | | | | | **2,3** |

**Conclusion.** It was observed that the heading phase of wheat varieties, new varieties and rows in the rainfed lands differed significantly from each other. In experiments, it was found that the heading phase of varieties differed by 28 days. In studies, the occurrence of the heading phase at an early date determines early maturity.

The early stages of the heading phase in the studied varieties determined early maturity, but the grain yield in early-ripening varieties was lower than in late-ripening varieties. However, in such early-ripening varieties as KSI-96/2024/Sp-1/447/2021 (Tagob), KSI-97/2024/Sp-1/834/2021 (Zartepa), Sp-1/382/2021

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(earlyripe), the grain yield was higher than Tezpishar variety. This result shows that other traits and characteristics also influence the high yield of early-ripening wheat varieties.

Also, during the studies, it was found that a large number of grains in a spike and a 1000s of kernel weight provide a higher yield compared to other productivity elements.

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