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New Varieties of Chickpea in Rainfed Fields

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Abstract: The article presents the results of research on the development of new local varieties of chickpea adapted to unfavorable soil and climatic conditions in rainfed lands. These varieties are resistant to drought, heat, diseases, and pests, while also being high-yielding. The study highlights the importance of incorporating economically efficient leguminous crops into crop rotation systems to maintain and improve soil fertility, thereby increasing production. Additionally, the research describes the development of early-maturing, drought- and disease-resistant chickpea varieties with 15–20% higher yield and protein content compared to the standard variety. The study also covers the initial seed production of promising chickpea varieties recommended for cultivation in rainfed areas.

Keywords: Crop, chickpea, legume, grain, variety, sample, row, hybrid, selection, crossing, standard, disease, yield, increase, seed production, quality.

Introduction: According to data from the international FAO (STAT) organization, the leading countries in chickpea production worldwide are India (8,832.5 ha) and Australia (813.3 ha).

In Uzbekistan, the Asian type of chickpea is widely cultivated. Its origin is considered to be Southwest Asia (specifically between Greece and Iran) and Asia Minor. According to Dekondol, it spread to India at a later stage.

Ramakrichna V. and Chatrath M.S. (1988) studied the introgression of genes from the wild species Cicer reticulatum into the cultivated species Cicer arietinum. Through 1-3 rounds of backcrossing between ICC 8923 (“Kabuli” type) and TZ (“Desi” type) varieties, they managed to reduce undesirable traits. The resulting hybrids demonstrated resistance to Ascochyta blight disease.

During the selection process, new varieties suitable for different conditions are developed and recommended for large-scale cultivation. This ensures the renewal of seed stocks, which, according to academician Gulyayev G.V. (1991), should be done as quickly as possible for maximum efficiency.

Dencic S. and S. Borojevic (1991) argued that high yields are not achieved solely by frequent irrigation or fertilization but also by selecting varieties best adapted to specific climatic conditions.

In Uzbekistan, interspecific hybridization in chickpea breeding has shown great success when using tall, drought-resistant, and Ascochyta blight-tolerant local and imported varieties. This was acknowledged in scientific studies by K.E. Eshmirzayev (1996).

According to research by I. Ernazarov (2012), in the rainfed fields of Kashkadarya region, chickpea has proven to be a good predecessor crop for cereal crops, increasing their yield by 50-60%.

Based on the analysis of the reviewed literature, incorporating chickpea, a leguminous grain crop, into

crop rotation systems with cereals in rainfed areas plays a crucial role in improving soil fertility and increasing net income per hectare. Moreover, selecting initial genetic sources for breeding high-yielding varieties resistant to abiotic and biotic stress factors, as well as improving agronomic practices for these new varieties, remains one of the most urgent tasks in modern agriculture.

METHODS

In the central experimental farm of the Rainfed Agriculture Research Institute, the Laboratory of Genetics, Breeding, and Seed Production of Leguminous Crops conducted studies on newly selected chickpea varieties and lines alongside local varieties during the 2020–2022 breeding stages.

All agronomic practices were carried out based on the recommendations and methodologies developed by the Gallaorol Scientific Experimental Station of RARI in 1994. Phenological observations and field and laboratory evaluations were conducted following the guidelines established by the State Commission for Crop Variety Testing (1985, 1989) and the former All-Union Institute of Plant Industry (VIR, 1985).

The experimental data were analyzed using dispersion mathematical analysis based on the methodology of B.A. Dospekhov (1985).

RESULTS

Results from the control field. In this experimental field, 24 lines were planted in 5 m² plots, with two replications, and Yulduz variety was used as a control. The growing period of the Yulduz variety in this experiment was 79 days, and compared to it, the lines with numbers 17553, 17560, 17130, and 17443 ripened 3-4 days earlier. In terms of plant height, lines 17553, 17560, and 17290, as well as those with lower pod placement, showed superiority over the control variety, with lines 17142, 17245, 17358, and 17421 being more favorable. The lines with the highest number of pods per plant (17-20 pods) were 17553, 17560, 17576, 17130, and 17261. The 1000 seed weight of the Yulduz variety was 331 g, and the lines with larger seeds, weighing 70-140 g or more, were 17198, 17290, 17421, and 17443. In terms of yield, the lines 17443, 17358, 17560, 17553, and 17421 were selected for initial variety testing, as their yield was 1.1-2.2 quintals higher per hectare compared to the control variety.

Results from the Competitive Variety Test Field. In this experiment, 16 pea variety samples were studied over 25 m² plots with 4 replications, totaling 64 plots over three years. Yulduz variety was used as the control. Observations and analyses were conducted based on valuable characteristics and traits for agricultural use (Figure 1).

Growth Period. According to the three-year research results, the growth period of pea varieties and lines ranged from 73 to 84 days on average. The growth period of the Yulduz variety was 80 days on average over three years, while the Lazat variety matured 7 days earlier and the Uzbekistan-32 variety matured 2 days earlier compared to the control.

Plant Height. This indicator varied over the three years due to different weather conditions, planting times, and the early maturity group classifications of the varieties. Specifically, in 2020, due to higher annual rainfall compared to other research years, all varieties and lines had taller plants.

According to biometric analysis conducted over three years, the plant height of the 16 varieties and lines ranged from 35.1 to 42.3 cm, with the Yulduz variety averaging 36.5 cm.

The experiments revealed that the following varieties and lines had taller plants than the Yulduz variety: Jahongir (38.2 cm), Guliston (38.0 cm), M-74 (40.4 cm), Istiqlol (40.6 cm), and FLIP 93-93 (42.3 cm).

Pod Placement Height. According to the research results, this indicator averaged between 19.2 cm and 22.3 cm in the studied lines and varieties. Compared to the control variety, the following lines and varieties had higher pod placement heights: FLIP 93-93 (22.3 cm), Mustaqillik-20 (21.6 cm), Jahongir (21.1 cm), Istiqlol (21.5 cm), and 14442 (20.6 cm).

Number of Pods per Plant. On average, over three years, this indicator was 22.5 pods per plant for the Yulduz variety. Higher numbers of pods were observed in the varieties and lines Lazat, Uzbekistan-32, Iroda-96, Javlon, and line № 14442 (Figure 1).

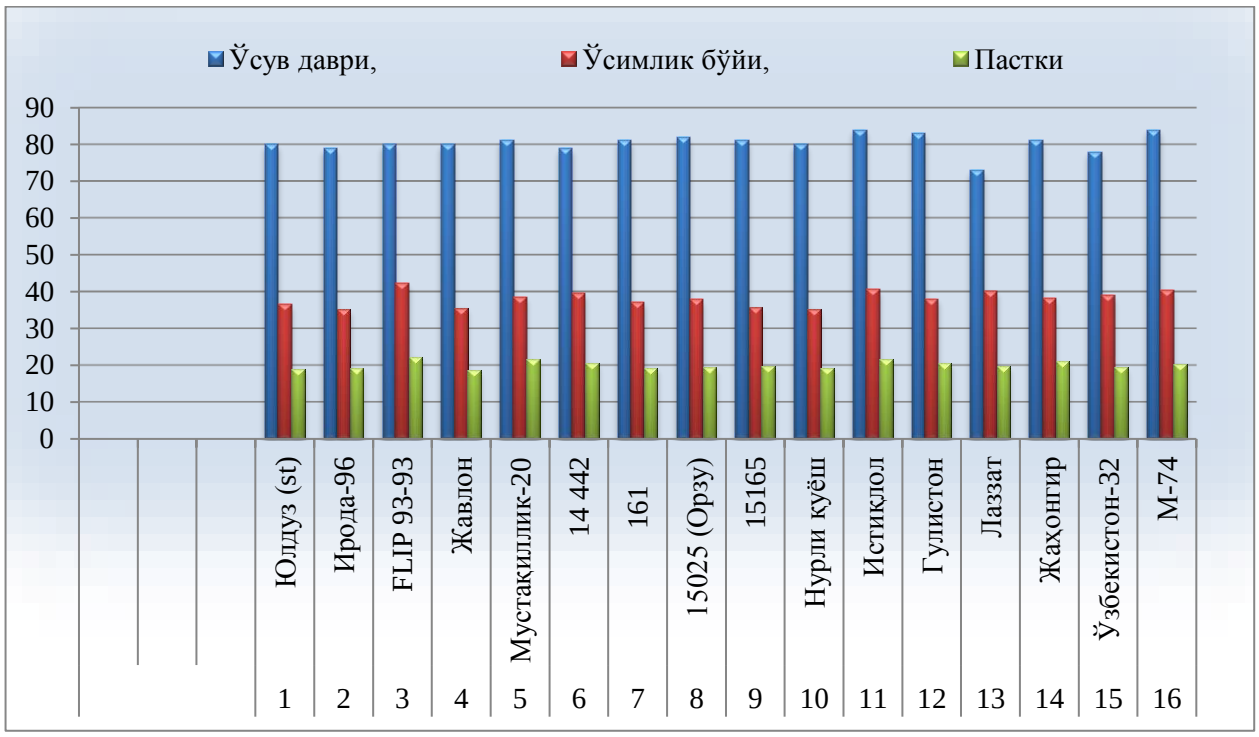

Figure 1. Valuable agricultural traits of pea varieties in the competitive variety test field (Gallaorol, 2022-2024).

According to the analysis results, the early-maturing pea varieties Uzbekistan-32, Javlon, and Iroda-96 had protein swelling temperatures in the leaf ranging from 58.5°C to 59.5°C, while the late-maturing varieties Istiqlol, Guliston, Orzu, 14442, and M-74 had swelling temperatures between 60.5°C and 61.5°C.

Additionally, one of the factors determining drought and heat resistance is the total water content in the leaves during the full pod development period. The highest water content was found in the early-maturing Javlon variety at 69.79%, followed by Iroda-96 at 68.86%, late-maturing M-74 line at 66.88%, and Guliston at 67.04%.

The total dry biomass weight was 73.8 g for the Yulduz variety, and it ranged from 77.7 g (Mustaqillik-20) to 117.0 g (Iroda-96) in all the other studied varieties and lines, as determined by physiological analysis in laboratory conditions.

Regarding the total dry biomass weight of the plants, the root system showed an increase of 4.8% in Iroda-96 and reached 8.8% in Istiqlol. Furthermore, the stem weight as a percentage of total dry biomass was 14.0% in Javlon and 28.8% in Jahongir.

In the studied varieties and lines, the leaf weight ranged from 20.3 g to 22.8 g in early-maturing varieties such as Lazat, Uzbekistan-32, Javlon, Jahongir, and line 14442, 13130/1, while it increased to 26.9 g to 28.8 g in late-maturing varieties such as Orzu, Istiqlol, and Guliston.

Pea Disease Resistance. As described in the weather condition analysis above, in May 2022-2024, the amount of precipitation was lower than average for the year, and the air temperature was higher and drier than the multi-year average. As a result, conditions were not favorable for the development of Ascochyta blight, a disease that causes significant damage to peas. Consequently, the Yulduz variety had a 20% infection rate with this disease, Mustaqillik-20 had a 15% infection rate, 13130/1 line had 30%, and 15165 line had 25%. No symptoms of this disease were observed in the other studied varieties and lines.

Number of Pods per Plant. This indicator averaged 22.5 pods per plant for the Yulduz variety over three years. In comparison, the number of pods was 27.2 in line 14442, 24.0 in Iroda-96, 31.8 in Lazat, and 23.4 in Nurli Quyosh.

1000 Seed Weight. Among the studied varieties and lines, the smallest 1000-seed weight was found in Lazat variety (180 g), while the largest was in M-74 (430 g). The Yulduz variety had an average of 305 g. The 1000-seed weight in M-74 (430 g), Guliston (375 g), Orzu (367.5 g), and Istiqlol (352.5 g) was 47.5-125 g higher than the control variety.

Seed Yield. From 2020 to 2022, the seed yield of 16 varieties and lines in the competitive variety test field varied. According to the research results over three years, the Yulduz variety yielded an average of 8.1 quintals per hectare. Ten varieties had seed yields 0.2-1.7 quintals higher than the Yulduz variety. Specifically: Iroda-96: 7.6 q/ha, Nurli Quyosh, Javlon: 7.5 q/ha,

Mustaqillik-20: 8.5 q/ha, Line 14442: 8.8 q/ha, Line 15025 (Orzu): 8.3 q/ha, Lazat: 7.5 q/ha, Jahongir: 7.6 q/ha. A complete description of these indicators is shown in Figure 2.

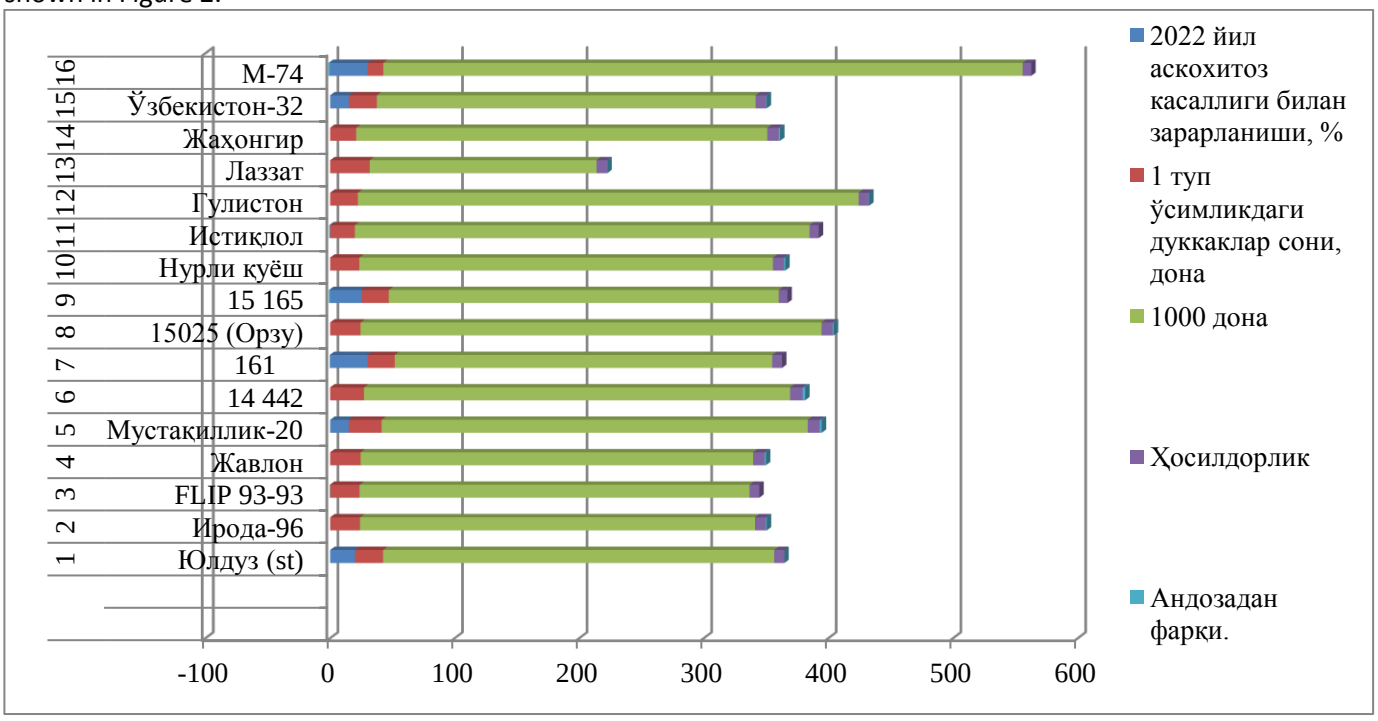

Figure 2. Disease resistance, productivity elements, and yield of pea varieties in the competitive variety test field (Gallaorol, 2022-2024).

Compared to the control variety, in the pea sample nursery, it was found that there were 28 very early-maturing and 165 early-maturing samples, 105 with taller plants (5-15 cm), 201 with a 1000-seed weight greater than 350 g, and 27 with higher yields (115.1-135% compared to the control Yulduz variety).

In the first-year selection nursery, 11 very early-maturing and 147 early-maturing samples were identified. Among them, 58 had taller plants, 107 had larger seeds, and 12 had high yields, which were selected for the next stage of breeding.

In the second-year selection nursery, 9 very early-maturing, 36 early-maturing, 12 with taller plants, 79 with higher 1000-seed weight, 15 with higher yields, and 8 with very high yields (lines No. 17538, 17553, 17584, 17627, 17132, etc.) were identified.

In the control variety test field, compared to the Yulduz variety, the early-maturing lines 17553, 17560, 17130, and 17443, as well as the high-yielding lines 17443, 17358, 17560, 17553, and 17421, were selected for the next breeding stage.

Based on the three-year research results in the competitive variety test field, compared to the Yulduz variety, the following lines were superior in specific traits:

Early-maturing: Lazat, Uzbekistan-32, Iroda-96, Taller plants: FLIP 93-93, Istiqlol, M-74, Guliston, Jahongir, Higher 1000-seed weight: M-74, Guliston, Orzu, Istiqlol, Higher seed yield: No. 14442, No. 15025 Orzu, Mustaqillik-20, Jahongir.

CONCLUSION

Regardless of weather conditions, the varieties that are resistant to drought, heat, and disease, as well as early-maturing, include Lazat, Uzbekistan-32, Iroda-96. Varieties with taller plants include FLIP 93-93, Istiqlol, M-74, Guliston, Jahongir. Varieties with higher 1000-seed weight include M-74, Guliston, Orzu, Istiqlol. Varieties with higher yield include No. 14442, No. 15025 Orzu, Mustaqillik-20, Jahongir.

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