A research on productivity of newly created cotton varieties and evaluation of cotton fiber quality indicators

Dilafruz Kazakova[1*], *Ilkhom* Abbazov[1], *Sojida* Gafurova[1], *Kumush* Baratova[1], *Khayrullakhan* Aripov[2], and *Irina* Allenova[3]

[1]Jizzakh Polytechnic Institute, 130100 Jizzakh, Uzbekistan
[2]Namangan Institute of Engineering and Technology, 160115 Namangan, Uzbekistan
[3]"Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" National Research University, 100000 Tashkent, Uzbekistan

Abstract. This article analyzes the productivity of early maturing and new cotton varieties grown in the country. The study was conducted on early ripening and cotton varieties grown in Jizzakh region. At that time, the highest yield was 37.1% in Bukhara-102 variety, and the lowest yield was 30.0% in Sultan variety. Yields in early maturing new varieties averaged 28.9%. The yield of Porloq-4 was 40.9%, and that of C-6779 was 23.0%. Yields of early maturing varieties averaged 33.3%. Porloq-4 and Bukhara-102 varieties have high indicators of early ripening and yield. Physico-mechanical performance of these cotton varieties was analyzed on the basis of HVI (High Volume Instrument) results. From the results we can see that the specific breaking strength of early maturing and new varieties Porloq-4 and Bukhara-102 in cotton fiber was 37.2%, the upper length was 35.5 mm. Then the specific tensile strength of Porloq-4 cotton fiber is 1.8% lower than the average tensile strength, and the upper average length is 5.1 mm higher. The specific tensile strength of Bukhara-102 fiber is 1.9% higher than the average tensile strength, the average length is 5.3 mm less. The short fiber index averaged 7.5% and the elongation at break was 7.9% on average. The short fiber index of the Porloq-4 variety is 3% lower than the average short fiber index, and the elongation index at break is 1.6% higher than the average. We can see that the index of short fibers of Bukhara-102 fiber is 3% higher than the average, and the elongation at break is 1.5% lower than the average.

1. Introduction

The main raw material of the textile industry is cotton fiber, which is the largest and most renewable source of natural fiber. It has several advantages over synthetic fibers in terms of its elegance and air permeability, as well as being an environmentally friendly product**.** Due to the fact that cotton fiber has similar positive properties, the demand for products made from this fiber is very high in countries around the world.

Market relations have been widely introduced into the cultivation of agricultural products, and a modern cluster form of organization of cotton and textile production has been introduced, and the practice of producing competitive finished products with high added value through deep processing of raw materials has been established [1].

The reduction of production costs can be achieved by reducing the cost of production through the cultivation and efficient use of high-yielding and fast-ripening varieties of cotton fiber grown in our country [2, 3].

Uzbekistan is one of the world's leading cotton producers. In recent years, the cotton industry of the country has created high-quality and high-yield cotton varieties that are resistant to early ripening, disease and pests, resistant to various adverse effects of nature [4].

Taking into account the soil and climatic conditions of the regions of the republic, disease-resistant, pest-resistant, fast-ripening and high-yielding cotton varieties that meet international standards and requirements for the quality of cotton fiber have been created. These include Genofond-2, Beshkahramon, Porloq-4, Pakhtakor-3, UzFA-713, Sadaf, Sarbon, C-6779.

Today in the districts of Jizzakh region are grown new early varieties Sultan, Bukhara-102, C-8290, Genofond-2, Beshkakhramon, Porloq-4, Pakhtakor-3, UzFA-713, Sadaf, Sarbon, C-6779. These newly created varieties give good

*Corresponding author: kazakovadilafruz123@gmail.com

results with their early ripening and yield.
The average yield of cotton varieties planted by cotton growers in 2021 in the districts of Jizzakh region was analyzed [5, 6, 7]. According to the results of the analysis, the yield of early maturing varieties planted in the region averaged 33.3%. At that time, the yield was 37.1% in Bukhara-102 and 30.0% in Sultan. At the same time, the yield of Bukhara-102 is 3.8% higher than the average yield of all varieties, and the yield of Sultan variety is 3.3% lower than the average yield.
From the results we can see that the yield of early maturing new varieties averaged 28.9%. The high yield was 40.9% in Porloq-4 and 23.0% in S-6779. Yield of Porloq-4 variety is 12% higher than the average yield of new varieties, C-6779 is 5.9% lower than the average yield of new varieties.
Medium-fiber cotton, which accounts for more than 95% of the world's cotton fiber, differs from other types of cotton in its productivity and high fiber yield. However, medium-fiber cotton varieties also have their own drawbacks, which are indicators of the quality of the fiber in them, which is shorter, coarser and less durable than fine fiber.
Currently, the indicators of cotton fiber are determined by the modern system of measurement HVI-1000 [8, 9, 10, 11]. According to the results, cotton fiber is divided into types and varieties according to the standards. According to modern standards, long-fiber cotton is divided into types I-III, and medium-fiber cotton is divided into types IV-VII, ie the linear density of the fiber increases with the order of growth of the type, and the length decreases inversely. If the fiber exceeds the limit in terms of linear density or length, it will pass to the lower types, resulting in a reduced spinning capacity of the yarn and the production of poor quality finished products. It is known from the results of a number of research studies that if the length of cotton fiber is increased by 1 mm, the strength of the obtained yarn will increase by 3-4%. This figure is especially important for medium-fiber cotton. The linear density of textile products, as well as cotton fiber, is expressed in the Republican standard in units of tex or millitex, and is estimated depending on the length and type of fiber.
We know that the structure of a fiber determines its properties. Cotton fiber is distinguished by its basic properties such as staple length, micronaire and specific tensile strength [12, 13]. These indicators provide quality indicators of the products produced from it. The raw material used in the spinning process, ie fiber, must meet certain requirements. Technological parameters of cotton fiber - physical, mechanical, geometric properties ensure the strength of the yarn obtained from it. Therefore, today it is necessary to use a modern measurement system that works with high accuracy in determining the performance of fibers.

2. Methods

Sampling of cotton fiber for the measurement process is carried out in accordance with the established procedure. To perform the measurements, the fiber must be at normal humidity.
Obtained samples determined by indicators such as short fiber index, yellowing rate, contamination code, minimum and maximum, relative breaking strength, inch length code, light reflection coefficient, color variation, average, micronaire index, relative elongation at break, uniformity index, high half length
The results obtained in the system are calibrated for micronaire, high average length, uniformity coefficient of length, toughness (relative tensile strength) using standard samples of cotton fiber at the start and end points of the measurement criterion.
Calibration of the HVI 1000 system on the fiber color index is performed by comparing the values of the reflection coefficient (Rd) and the degree of yellowing (+b) with the color of the ceramic samples. Calibration of the HVI 1000 system according to the contamination index is carried out depending on the plate with points similar to the contaminants.
The micronaire index is a measure of a fiber's maturity and its fineness in terms of its natural linear density. A microner (Mic) indicator appears on the monitor. If the micronaire reading is less than 2.0 or higher than 7.0, the monitor will display the text "Inconsistent micronaire" ("Improper micronaire"). In this case, the measurement operation is repeated. Measurements on all indicators are carried out in the prescribed manner.
Determining the linear density of cotton fibers is complex enough. Therefore, the American fiber certification system has introduced a micronaire indicator, which is determined by the amount of air consumption from a group of parallel fibers. The air resistance is proportional to the cross section of the fiber.

3. Results and Discussions

The new varieties, we analyzed above, were mainly medium-fiber cotton, and the physical and mechanical characteristics of these varieties were studied (Table 1).
The fiber color is characterized by the American standard Rd (%) and yellowing (+ b). The color of cotton fiber has always been one of the highest demands. Therefore, the acceptance of cotton fiber in the country is carried out only during the day, and laboratory technicians determine the color of the fiber by comparing it with subjective, classy style

and special samples.

Table 1. Results of new varieties in the HVI system

Sort name	Mic Micronaire value	Str Fiber Strength g / tex	Ltn Upper Half Mean Length, dm	Unf Uniformity index, %	SFI Short fiber index	Elg Fiber elongation, %	Cnt Trash Count	Rd Reflectance	+b Yellowness
Porloq-4	4.4	35.7	1.60	83.9	4.5	9.5	13	81.6	9.0
Buxoro-102	4.6	39.1	1.19	85.2	10.5	6.4	18	81.9	10.6

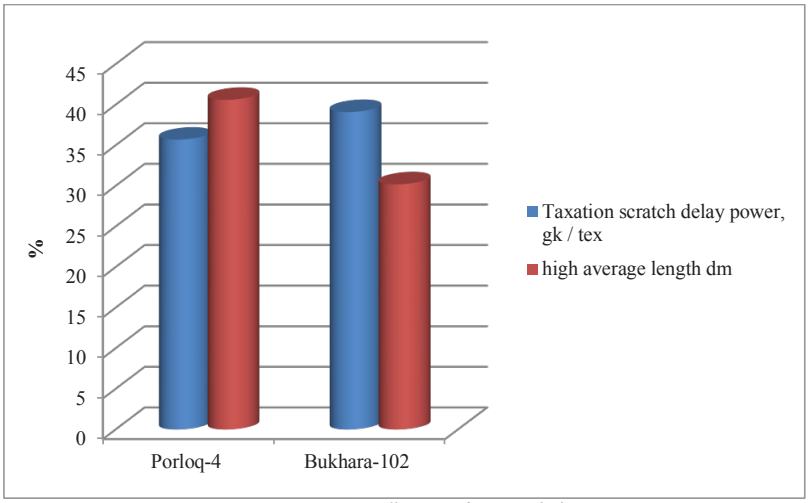

Fig. 1. Indicators of new varieties

Figure 1 shows that the specific breaking strength of early maturing and new varieties Porloq-4 and Bukhara-102 in cotton fiber was 37.2%, the average average length was 35.5 mm. Then the specific tensile strength of Porloq-4 cotton fiber is 1.8% lower than the average tensile strength, and the upper average length is 5.1 mm higher. The specific tensile strength of Bukhara-102 fiber is 1.9% higher than the average tensile strength, the average length is 5.3 mm less.

Porloq-4 cotton variety is characterized by high morpho-biological, economic characteristics and technological-qualitative indicators. The vegetation development period of the variety is 110-115 days and the fiber yield is 38%, fiber length 36.0 mm, fiber length (Len) -1.24 inches, micronaire 4.3 fibers belong to industrial type III [14, 15].

Today, "Porloq" cotton fiber is sold at a price 12% higher than other varieties grown in our country and is in great demand in the world market.

Cotton varieties of the "Porloq" series are distinguished by their resistance to drought, saline soil conditions, as well as fiber length and, consequently, quality. Such long-fiber cotton varieties were previously only found in Egypt, but it takes 270 days to grow the Egyptian cotton variety. Varieties of the "Porloq" series are genetically modified in such a way that they open within 90-100 days after planting.

As a result of yellowing of the cotton fiber color, the fiber strength, specific tensile strength, staple mass length decreases, the amount of short fibers and mechanical damage of the fiber increases [16]. Due to the increase in the amount of mechanical damage to the fiber, firstly, the length and strength of the fiber decreases, the proportion of short fibers also increases, and secondly, it has a negative impact on the quality of the yarn [17, 18, 19].

Figure 2 demonstrates that in the early maturing and new varieties Porloq-4 and Bukhara-102 the index of short fibers averaged 7.5%, the elongation at break was 7.9% on average. The short fiber index of the Porloq-4 variety is 3% lower

than the average short fiber index, and the elongation index at break is 1.6% higher than the average. The short fiber index of Bukhara-102 fiber is 3% higher than the average, the elongation at break is 1.5% lower than the average.
According to modern standards, long-fiber cotton is divided into types I-III, and medium-fiber cotton is divided into types IV-VII, ie the linear density of the fiber increases depending on the order of growth of the type, while the length decreases inversely. If the fiber exceeds the limit in terms of linear density or length, it will pass to the lower types, resulting in a reduced spinning capacity of the yarn and the production of poor quality finished products.

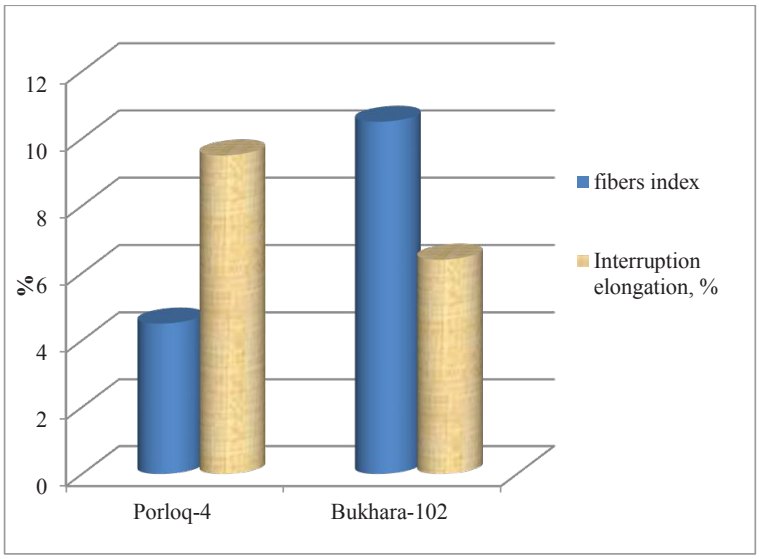

Fig. 2. Indicators of early ripening and new varieties

4. Conclusions

Among the newly created early maturing varieties, Porloq-4 and Bukhara-102 varieties were found to have higher productivity and technological indicators than other varieties. The use of these varieties in the production of yarn will increase production.

References

1. D. Kazakova, K. Jumaniyazov, I. Abbazov, Change of physical and mechanical indicators of yarn depending on the design of the sampling drum, *Journal of Critical Reviews* **7**, 411-415, (2020)
2. K. Jumaniyazov et al., Study on the influence of the cotton storage process on the quality indicators of fiber and yarn, *IOP Conference Series: Earth and Environmental Science* **939**, 012053 (2021)
3. D. Kazakova, K. Jumaniyazov et al., Influence of different blend composition on mechanical damage and fiber length at the transitions of spinning processes, *Textile Industry Technology* **5**, 115-118 (2019)
4. M.T. Khojiev, I.Z. Abbazov, O.N. Alimov, Ways to efficiently cleaning of cotton waste produced at cotton cleaning factories, *Textile Journal of Uzbekistan* **1**, 2 (2019)
5. M. Khodjiev, I. Abbazov, O. Alimov, R. Karimova, The Dusty Composition of the Passion of Dusty in the Pat, *Process Journal of International Engineering and Advanced Technology* **8**, 279-283 (2019)
6. M. Khodjiev, I. Abbazov, O. Alimov, J. Karimov, Fraction Structure of Cotton Cleaning Equipment in Cotton Enterprises and their Cleaning Effectiveness, *International Journal of Advanced Research in Science, Engineering and Technology* **6**, 7983-7988 (2019)
7. Y.A. Muhammadov, K.E. Mirzayoqubov, Sh.I. Mamanazarov, Technological quality indicators of medium-fiber bright-4 cotton varieties, *International Conference on Modern Problems of Genetics, Genomics and Biotechnology*, Tashkent (2020)
8. Ch. Heng, L. Chen, H. Shen, F. Wang, Study on the measurement and evaluation of cotton color using image analysis, *Mater. Res. Express* **7**, 075101 (2020)
9. X. Cui, T.A. Calamari, K.Q. Robert, J.B. Price, M.D. Watson, Measuring the Short Fiber Content of Cotton, *Textile Research Journal* **73**(10), 891-895 (2003)

10. A.F. Tesema, M.A. Sayeed, C. Turner, B.R. Kelly, E.F. Hequet, An Approach for Obtaining Stable, Reproducible, and Accurate Fibrogram Measurements from High Volume Instruments, *Agronomy* **12**(5), 1120 (2022)
11. R.L. Long, M.P. Bange, Ch.D. Delhom, J.S. Church, G.A. Constable, An assessment of alternative cotton fibre quality attributes and their relationship with yarn strength, *Crop and Pasture Science* **64**(8), 750-762 (2013)
12. R.W. Mathangadeera, E.F. Hequet, B. Kelly, J.K. Dever, C.M. Kelly, Importance of cotton fiber elongation in fiber processing, *Industrial Crops and Products* **147**, 112217 (2020)
13. X. Wang, L. Zhang, J.B. Evers, L. Mao, Sh. Wei, X. Pan, X. Zhao, W. van der Werf, Zh. Li, Predicting the effects of environment and management on cotton fibre growth and quality: a functional–structural plant modelling approach, *AoB PLANTS* **6**, plu040 (2014)
14. D. Kazakova, K. Jumaniyazov, I. Abbazov, Effect of incredible constitutional elements on product quality indicators, *International Journal of Research* **7**, 1011-1017 (2020)
15. D. Kazakova, K. Jumaniyazov, I. Abbazov, Effect of incredible constitutional elements on product quality indicators, *International Journal of Advanced Research in Science Engineering and Technology* **7**, 12356-12367 (2020)
16. D. Kazakova, K. Jumaniyazov, A. Salomov, Change of physical and mechanical indicators of the produced yarns depending on the mixture composition, *NETI Scientific Technical Journal* **5**, 3-8 (2021)
17. A. Usmankulov, I. Abbazov et al., The results of preliminary studies and the choice of the direction of research to improve the UXK unit for cleaning raw cotton from machine collection, *Actual Problems of Modern Science, Education and Training* **9**, 82-93 (2021)
18. K. Jumaniyazov, M. Ismatova et al., Effect of discrete drum constructive elements on product quality indicators, *Actual Problems of Modern Science, Education and Training* **9**, 84-90 (2021)
19. D. Kazakova, K. Jumaniyazov, Influence of Composition of the Mixture on the Fiber Length on Transitions of the Spinal Process, *International Journal of Advanced Research in Science Engineering and Technology* **6**, 9180-9186 (2019)