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Evoluation of Valuable Economic Characteristics of Systems Made by Introgressive Methods of Cotton

Bakhtiyar Amanov, Nilufar Tursunova
Department of Genetics and Evolutionary Biology, Chirchik State Pedagogical University, Tashkent Region, Chirchik city, Amir Temur, Uzbekistan

Abstract: This article reveals the results of the study on precocity of cotton lines, such as opening rate of cotton bolls of introgressive lines that were found to ripen 2-13 days earlier than a model sample C-6524 cotton variety. Particularly, in T-PCM line the vegetation period made 109 days that was noted to be preucious for 12,3 days than a model sample variety. The selected lines according to their cotton weight in one boll were determined to have high indicators, as well as on germinability of plant seeds. The results of the cluster analysis by economic traits in the lines showed that according to the economic traits, the first cluster included lines T-24 and T-138 were found to be closely related to each other. The line T-PCM was included to the third cluster, and it was found that this line was among the varieties with high indicators on all valuable economic traits. As a result of comparative analysis of lines, a new medium-fiber cotton cultivar "Niso" was created with productivity of 38,3-56,5 c/ha, cotton weight in one boll 6,0-6,7 g, precocity of 109,0-112,0 days, fiber, the weight of 1000 seeds 118,0-120,0 g, fiber length of 34,0-35,9 mm, fiber yield of 36,9-41,4 %, relative tensile strength of 34,6 cN/tex.

Keywords: cotton, genome, cultivar, boll, fiber, yield, introgressive line.

INTRODUCTION

The research of today aimed to improving the economic and quality indicators of upland cotton in the world focuses particularly on a wide use of wild species, especially the involvement of interspecific hybridization, obtaining rare genetically enriched hybrids using experimental polyploidy methods and creating new varieties with high economic and quality indicators from the existing cultivars under cultivation presently. Recently, rare amphidiploids, recombinants, families, and lines have been obtained using wild species of cotton *G.harknessii Brandg, G..klotzschianum Anderss, G.raimondi Ulb., G.laxum Phill., G.bickii Prokh., G.australe F.Mull*, and other species. One of the urgent tasks on the study of these lines is to determine the genetic regulations of morphological-economic traits, such as heredity, variability and correlation [1-17].

At present, as a result of the creation of new varieties of cotton with a new genotype, interspecific hybridization with the participation of intergenomic cultural and wild species, as well as the use of experimental polyploidy methods, native scientists A.A. Abdullaev et al. (2020), B.Kh.Amanov et al. (2020), Kh.A.Muminov (2020), B.A.Sirojiddinov (2020) and also foreign scientists, Wendel, J.F., R.C. Cronn (2003), H.Benbouza et al., (2010), Yu Chen et al., (2014), J.Sh. Shavkiyev et al. (2020, 2021) have created unique hybrid forms with high economic characteristics, primary sources resistant to stress factors based on the hybridization of wild species of cotton with cultural varietal samples and isolated new genetically enriched genotypes, as well as recommended primary donors for practical selection. For example,

B.A.Sirojiddinov (2020) created new interspecific complex hybrids based on hybridization of complex *(G. thurberi* Tod.x *G. raimondii* Ulbr.*) G. arboreum* L.x *G.hirsutum* L. amphidiploids with cultural varieties *G.hirsutum* L. and *G.barbadense* L. involving 4 and 5 cotton species, and also he determined the formation and variability of main valuable economic traits.

B.A Sirojiddinov (2020) made a comparative assessment of the inheritance, degree of variability and formation of valuable economic traits in polygenomic hybrids created using interspecific hybridization and experimental polyploidy methods. It should be emphasized that the research on obtaining introgressive forms using the hybridization of multi-genomic wild cotton species and experimental polyploidy methods, on the formation of morphological features in the lines on the basis of the obtained forms, and as well as on their correlation is of scientific importance.

MATERIALS AND METHODS

Cotton lines T-24, T-PCM, T-138, T-141 obtained under intergenomic introgressive methods were used as an object of the study. As well as, zoned model sample C-6524 variety was used to compare and analyze the lines obtained by experimental polyploidy method of three-genome Tashkent - 1 x (*G. raimondii* x *G. thurberi*), Tashkent - 1 x (*G. harknessii* x *G. raimondii*) hybrid combinations belonging to *Gossypium* L. family. The study was carried out in Genetics and Experimental Plant Biology Institute and Genetics and evolution biology department of Chirchik state pedagogical institute in Tashkent region.

RESULTS AND DISCUSSION

It is known that one of the most important indicators of the precocity of cotton is the period from the date of germination to the opening of 50% of the pods. When comparing the trait on vegetation period by results of 2017-2019 in multi-genomic lines, a significant difference was not observed in this trait. In C-6524 variety which was studied as a model, this trait showed average 119,4-122,1 day by years. According to the trait of vegetation period, an average three-year data in the lines constituted 109,2-117,7 days, that is, 1,7-12,9 days earlier (precocious) than in model C-6524 variety. In particular, there was a slight change in studied T- PCM line over the years, i.e., according to the results of 2018-2019, this line was found superior over all lines and its average rate was ±109.2 days.

In our study, a comparative analysis of the trait on the first joint of plant with yielding branch was made according to the results of 2017-2019, no sharp differences were observed on this trait in the introgressive lines, and in model C-6524 variety it was average 5,1-5,5 joints over the years, with a coefficient of variation of 13,5–17,3% respectively. The average rate in the lines on this trait was 3,9-5,5 joints. It was noted that a good result on the trait of the joint of plant with the first yielding branch was 4,2 joints in T- PCM line, and the coefficient of variation was 19,0%, and a slightly lower value on this trait was 6,2 joints on T-138 line, that is a lower result than in C-6524 variety.

When the trait on cotton weight in one ball was studied comparatively by the results of the years 2017-2019, this trait in model sample C-6524 variety was average 5,2-5,5 gramms by years. In the lines the rate was average 5,7-7,1 gramms on this trait, that is, comparing to model C-6524 variety the lines were found to have 0,3-1,6 gr heavier cotton weight in one boll.

According to the results of 2017, cotton weight in one boll in multigenomic lines made 5,8-6,4 gr. The highest indicator on this trait was noted in T-PCM line, 6,4 gramms with variation cofficient of 7,8 %, and a slightly lower indicator was observed in T-138 line, 5,8 gramms, but showed +0,6 higher indication than in model variety C-6524. By the results of the second and the third years (2018-2019), analogue indicators were recorded on the trait of cotton weight in one boll. The aforementioned large-boll lines, T-PCM (6,7 g), T-24 (7,1 g) are recommended to be used in practical selection process as a primary material.

A comparative analysis of the trait on fiber length by the results of 2017-2019, which is one of the important indicators of cotton, showed similar results in the lines on this trait. Fiber length

trait was noted to be average 33,6-35,9 mm, comparing to model C-6524 variety 0,5-2,8 mm higher indication was found. The highest result on fiber length trait was observed in T-PCM line, 35,9 mm with variation coefficient of 4,37%.

According to the second and the third year (2018-2019) results, similar rates were recorded on fiber length trait. For example, on the results of 2019, T-141 line showed 33,6 mm, variation coefficient of 3,6%, lower than other lines, while T-PCM line had the highest indication - 35,1 mm among other lines.

The above analyzes showed that the fiber length trait of the 4 lines was superior to the model variety. This indicates that the results of the lines on the fiber length trait fully complies with the requirements for type IV fiber, and in further research to increase the lines it assures that the yield and fiber length trait will not decrease.

When the results for 2017-2019 on the fiber yield trait were analyzed comparatively, some lines had differences on this trait. In particular, if we look at the results of the analysis in 2017, a lower figure was observed than in 2018-2019. On fiber yield trait, the lines had average 36,8-38,5%, that is, 1,9-3,6% higher indication was recorded comparing to model C-6524 variety.

According to the research analysis of the second and third (2018-2019) years, as a result of the proper conduct of individual selection work, very good results were obtained on the fiber yield trait. For example, when the results of 2018 were analyzed, average 40,3-41,7%, variation coefficient 4,0-6,1% were recorded on this trait, it indicated 5,1-6,5% more fiber than in model variety. As well as, in T-141 line the highest indication 41,7% was noted by fiber yield, with variation coefficient of 4,0%, lower indicator on fiber yield trait was observed in T-PCM line, average 40,3%, with variation coefficient of 6,1%.

When the lines were comparatively analyzed by the trait of the weight of 1000 seeds according to the results of 2017-2019, no significant differences were observed in the lines on the three-year data. The trait of the weight of 1000 seeds in model C-6524 variety over the years made average 115,6-117,0 gramms, while the variation coefficient of 1,2-4,2% respectively. In the lines, this rate was found to be average 109,1-120,3 gramms, that is, 0,3-5,5 gramms heavier than in model C-6524 variety. The analysis of the results of the study showed that the degree of variability of multi-genomic lines on this trait was not significantly different from each other, that is at the level of the model variety, and also showed that the lines were stabilized on the trait of 1000 seeds weight.

The quality indicators of cotton fiber are analyzed using modern HVI equipment. Therefore, in our research, the quality indicators of new lines of cotton made based on different genomic species were determined using HVI equipment at the Republican Center “Sifat” (Quality) and the data obtained on some quality indicators of fiber were compared with the data on fiber of zoned model variety C-6524.

When micronaire indicator of the cotton lines was analyzed in 2017-2019 in the center “Sifat”, it was found to be between 4,1-4,8 мic. In 2017, the best result on micronaire trait was recorded in T-24 line (4,3 мic), which matched to the “base” interval application. Micronaire indication of cotton fiber was within 4,6 мic in 2 lines out of 4, constituting 50,0 % of all studied lines. Only in T-138 line this indicator was 4,4 мic, which was determined to be equal with the indication of model variety C-6524. No micronaire, less than 3,4 mic and more than 5,0 mic, which is one of the qualitative characteristics of the different genomic lines, were recorded, i.e., the lines that met the “discount” criteria were not recorded. According to the second and third year data, analogue indicators on the micronaire trait were recorded. For example, in the T- PCM cotton line analyzed under this trait, there was a slight positive change over the years, i.e., according to the results of 2018-2019, this line with 4.1 mic matching “premium” interval application was found to be superior to all lines on this trait. The micronaire trait of the lines is significantly positive than that of the model C-6524 variety, which fully complies with the requirements for type III-IV cotton fiber belonging to the medium-fiber cotton varieties on the micronaire index.

In our research, from the fiber quality indicators, the specific tensile strength (Str) - strength of cotton fiber was also analyzed. The fiber strength is expressed in the HVI Calibration Cotton of this calibrated cotton, in cN / tex. According to the results for 2017, the trait of the specific tensile strength of fiber was between 32,1 cN/tex (T-141) and 35,4 cN/tex (T-35,4) in all analyzed multigenomic lines and the difference from a model variety made 7,8-11,1 cN/tex. In 2018-2019, positive results were recorded on the trait of the specific tensile strength (Str) in all multigenomic lines. In C-6524 variety which was taken as a model sample, the specific tensile strength made 24,3-27,0 cN/tex.

Analysis of the results obtained on the quality of cotton fiber shows that the indicators of all different genomic lines were found to be positive in terms of fiber quality and fully meet the current requirements for the quality of cotton fiber. One of the main reasons for this is a good fiber quality of cultivated and wild species of cotton involved in the production of lines, the separation of transgressive forms of introgressive plants obtained on the basis of experimental polyploidy and the proper selection process, as well as the creation of new lines with high fiber quality.

In our experiments, the division of the lines into clusters was determined using the Euclidean distance as a measure of genetic proximity in the Statgraphics computer program, and the Ward method as a method of combining. In particular, D. Heilegiorgis, Kh.Muminov, Z. Ernazarova, B.Amanov [2020] determined by cluster analysis method the occurrence of genetic variability among the genotypes in a significant degree in order to evaluate yield traits genetically, this case, accordingly, shows the availability of increasing the yield at the expense of using the genotypes found in clusters for the hybridization of genotypes.

Quantitative traits of multigenomic lines were used for cluster analysis. The economic traits of these lines were studied, and the parameters on the weight of cotton in one boll, weight of 1000 seeds, fiber length, fiber yield were determined and statistically analyzed in laboratory and field conditions.

From the studied samples, the highest rate on the trait of the weight of cotton in one boll was noted in T-PCM line (6,4 gr), while lower rate on this trait was in the plants of T-138 line (5,9 gr). In the remaining lines, an average rate on this trait ranged between 6,2-6,3 gr. The minimum number of cluster to which the lines combined was 2, the maximum number was 4. When the division of lines into the clusters was analyzed, the third cluster was found optimal for the determination of proximity of cultivars by their valuable econmic traits (fig.1).

An analysis of the results obtained shows that although the lines T-24 and T-138 which were included in the first cluster, differed from each other in the size of their bolls, it was found that they were closely related lines on their valuable farm traits. The economic traits of T-141 line, which is included in the second cluster group of the cluster system, is higher than other samples and plays an important role in the creation of medium-fiber high-yielding varieties. T- PCM line was included in the third cluster, and it was found among the high-yielding varieties by its all valueable economic traits, and it was determined that these lines could be used in the selection process.

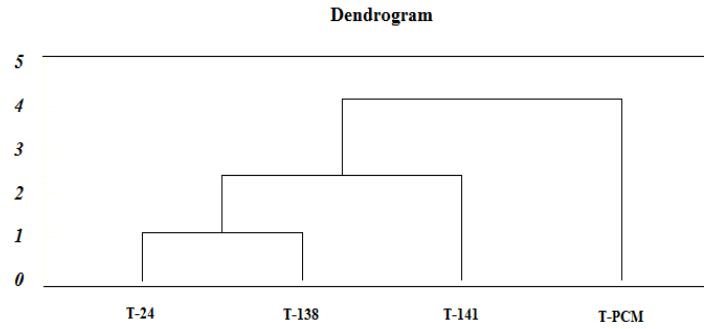

Figure 1. Diagram of division of the lines into cluster by their economic traits.

If more than two populations were obtained to determine fiber quality indicators, then the genotypes were divided into 3 groups according to their proximity to each other. For this purpose, the cluster analysis method was used to determine the degree of diversity of these introgressive lines on qualitative traits and to combine them according to their relative proximity.

Fiber quality traits of introgressive lines were used for cluster analysis. In these lines, the quality characteristics and micronaire, specific tensile strength, fiber upper half mean length were determined and statistically analyzed by planting the lines under the same conditions. When we analyzed the quality characteristics of the lines, the minimum number of combined clusters was 1 and the maximum was 3. When analyzing the division into these groups, it was found that a 3-cluster analysis was most moderate to determine the proximity of the varieties on valuable economic traits.

One of the most important tasks in the world cotton growing is to increase the efficiency of primary raw materials that are resistant to various adverse factors, diseases and pests.

As a result of comparative study and analysis of valuable economic traits and features of the lines obtained on the basis of introgressive methods, the research was continued to bring the remarkable lines to the varietal level and their introduction into production. During the study, the selection of the line T- PCM resulted in the creation of new medium-fiber cotton cultivar “Niso”, and the parameters on valuable economic traits of this new cultivar were submitted to small variety testing in Zangiota Experimental Base of the Institute of Genetics and Experimental Plant Biology at the Academy of Sciences of the Republic of Uzbekistan and the State Variety Testing Center of agricultural crops. The new medium-fiber cotton cultivar “Niso” successfully passed ground control in 2019 and since 2020 is being tested at VTC branches in the country (Table 1).

Table-1. Reference of Variety Testing Center branches for “Niso” cultivar (comparing to model cultivars for 2020 on average indicators)

Cultivars	Average yield, c/ha	Vegetation period, day	Cotton weight in one boll, g	Fiber yield, %
Fergana variety testing branch				
C-8290 model	45,5	126,0	6,0	35,7
Niso	56,5	124,0	6,5	36,9
Khatirchi variety testing branch				
Bukhara-6 model	40,8	115	6,3	33,4
Niso	41,5	110	6,4	37,1
Mingbulok variety testing branch				
C-6524 model	40,5	118	5,6	35,4
Niso	42,5	118	6,1	36,5
Termez variety testing branch				
Beshkahramon model	37,5	111	4,7	34,6
Niso	38,3	110	5,9	38,1

As a result of the research conducted, it was found that the new medium-fiber cotton variety “Niso” is integrated in terms of economic and quality traits, and is now competitive with the regionized varieties of medium-fiber cotton in the country. The new medium-fiber “Niso” cotton variety has high fiber yield and quality indicators, technological properties and the quality of the fiber fully comply with the requirements of type IV, as well as its high yield, disease- and drought –resistance traits indicate its superiority over other regionized varieties, gives high results in production after introduction.

CONCLUSION

Analysis of the results obtained showed that the rate of boll opening of the introgressive lines was 2–13 days earlier than that of the model C-6524 variety. It was found that the lines selected by weight of cotton in one boll had high performance, which was significantly superior to the model variety. Under the influence of strains of pathogen fungi *Fusarium oxysporum* f.sp. *vasinfectum* on plant seed germination, T-138 line showed strong resistance, and the lines T-PCM and T-138 were found to have 80,0-100,0% tolerance to *Verticillium dahliae* fungi. It was also observed that T-PCM, T-141 lines didn't get damaged by *Fusarium* solani, and the biomaterials of leaf samples of T-24 and T-PCM lines were not infected with *Verticillium dahliae* phytopathogen fungi. The results of the cluster analysis of valuable economic traits in the lines showed that the T- PCM line was included in the third cluster, and that this line was among the varieties with high rates by all economic traits, which could be used in the selection process. As a result of comparative analysis of the lines, a new medium-fiber cotton cultivar "Niso" has been created with the ndicators of plant height 100,0-110,0 cm, productivity 38,3-42,5 c/ha, cotton weight in one boll 6,0-6,7 g, precocity 109,0-112,0 days, fiber of IV type, weight of 1000 seeds 118,0-120,0 g, fiber length 34,0-35,9 mm, fiber yield 36,9-41,4 %, relative tensile strength 34,6 cN/tex.

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