

Formation of yield elements in composite hybrid families of cotton

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Abstract. A report on the execution of the 2019–2021 strategic plans and their control was presented at the ICAC international organization's annual report conference on October 1, 2020. Also, it was reported that the output capacity of these businesses and factories plummeted by 75% in nations like Vietnam, Bangladesh, and India. The global climate change, the emergence of new races of disease-causing agents and the numerous damages caused by harmful insects indicates the need to create new varieties of cotton that are resistant to adverse factors. The use of the O-3406, O-3407, O-3398, O-3411 and O-2757 families and the created T-3377, T-3378, T-3379 lines based on composite hybridization to achieve positive results in the process of creating especially productive varieties. efficiency is highlighted. The obtained results were subjected to statistical analysis according to the Dospekhov method. The results showed that from the families obtained on the basis of double hybridization, O-31 (F4 Tashkent-6 x Bukhara-6) had a relatively high result, which was 24.8 units. In the rest of the families in this block, it was noted that the indicator according to the sign was from 22.8 units to 24.10 units.

1 Introduction

At the annual report meeting of the ICAC international organization held on October 1, 2020, a report was given on the implementation of strategic plans for 2019-2021 and their control. In addition, in countries such as Vietnam, Bangladesh and India, it was stated that the production capacity of such enterprises and factories decreased by 75% [1-4]. In order to ensure food security in the upcoming 2020-2021 farming season, it was predicted that the total yield will decrease to 25.1 million tons as a result of the reduction of cotton areas in a number of countries. Despite this, the report states that the consumption quotation of cotton raw materials will increase by 24.3 million tons or 7.2% in the coming year compared to the previous (2019-2020) season [1-5].

Today, 90 percent of the cotton fiber grown in the world belongs to the cultivated *G. hirsutum* L. varieties. In 86 countries where cotton is grown, 20-22 mln. Tons of fiber are extracted and exported [1-6]. One of the important problems in cotton breeding is the creation of high-yielding, fast-maturing varieties with high fiber yield and quality and their

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wide use in production [4-7]. Due to the increase in the number of people on the earth and the reduction of irrigated arable land, it is important to get a high-quality harvest suitable for different soil and climate regions without expanding the arable land in the agriculture of the countries of the world [6-10].

The global climate change, the emergence of new races of disease-causing agents and the numerous damage caused by harmful insects indicate the need to create new varieties of cotton that are resistant to adverse factors [4-8]. This problem can be solved by attracting new donors with unique characteristics to the selection work. It is competitive and has a high yield in our republic extensive activities are being carried out to create new cotton varieties.

Today, the creation of productive cotton varieties suitable for different soil and climate regions is urgent in our country, and a number of researches are required in this regard. The purpose of this work is to create high-yielding, early, high fiber quality and yield, resistant to some diseases starting materials for practical selection by means of composite hybridization in medium fiber cotton [1-4, 8-10].

2 Materials and methods

As the object of the research, the varieties of cotton belonging to *G. hirsutum* L. type Sultan, Jarkurgan, L-151, Gulistan, Tashkent-6 and Bukhara-6 and their hybrids were used. The subject of the study is the transgression of characters in sources obtained in paired and composite cross-breeding methods and the study of correlations between valuable economic traits of hybrids in hybrids is to determine [4-7, 9]. Analysis of hybridization, single selection and inheritance of traits from generation to generation, laboratory and field experiments. The obtained results were subjected to statistical analysis according to the Dospekhov method [11].

In recent years, special attention has been paid to the creation of new varieties of cotton that can meet the modern demands of production, with high yield, high fiber quality, and resistance to various honey and pests, and to increase the yield [9-11]. We can say that it has been proven that it is important to create productive new varieties from various complex crossbreeding methods between species and varieties by effectively using the potential of wild and semi-wild species in the global cotton gene pool [2]. Currently, in order to create new varieties of cotton that meet the world standards, it is necessary to carry out various simple and complex crossings with the varieties belonging to the *Gossypium* L. family, to study the inheritance of unique and valuable economic traits in hybrid generations, to evaluate the valuable economic traits of high-generation hybrids and selection materials and their effective use of genetic potential in genetics and selection practice is required [3].

In recent years, extensive scientific and practical reforms have been carried out in the field of cotton cultivation. On the basis of the measures used in this direction, many achievements have been made in the creation of new varieties of cotton with improved yield and fiber quality. It should be noted that the success of breeding depends on the methods of crossbreeding and how much genetic variation they produce [4-7]. The method of hybridization chosen by breeders depends on the extent to which valuable economic traits of the parent pairs are heritable in the resulting hybrids. In the process of selection, the initial materials and varieties created by scientists using various methods of hybridization (simple hybridization, complex hybridization, hybridization of forms within a species, hybridization of distant forms in terms of geographical origin and interspecies hybridization) are widely used. In cotton breeding, breeders try to maximize the variability of traits by using and improving different parental forms and different methods of

hybridization when crossing hybrids [1-7, 10]. It should be noted that in the process of selection there should be recombinants with different genotypes. The higher the number of heterozygous loci in the starting hybrids, the higher the chance of isolating forms with different complex genotypes in the second and subsequent generation hybrids.

The complex hybridization method ensures the diversity of heterozygous loci, expands the range of variability of valuable traits of breeding materials, increases the ability of created varieties to adapt to local soil and climate conditions, and achieves the efficiency of selection work. By using the method of complex breeding, it is possible to increase wide variation in hybrid populations and ensure high productivity in subsequent generations [5]. In the field of breeding, many scientists have proven that, in addition to the methods mentioned above, it is possible to effectively use the method of composite hybridization (combining important traits in one genotype by crossing a large number of hybrid generations) to create productive varieties of cotton that are resistant to various diseases and insects [6]. Types of hybridization in plant selection: double hybridization, repeated hybridization, stratified hybridization, as well as complex hybridization occupy the main place in the work of scientists of many foreign countries, including our country [7,8, 9]. The wide range of possibilities of using different, i.e. double, complex and double hybrid breeding methods in cotton and other plants has been studied in many breeding researches.

The effectiveness of the complex hybridization method depends on how well the selected initial parental forms transfer useful characters to new varieties. The effectiveness of complex hybridization in the selection process is that, as a result of the use of the method, it is possible to embody the unique characteristics of varieties of different genetic origin in a single genotype in a short period of time [1-4]. It is noteworthy that in the hybrids created on the basis of the complex hybridization method, the variability of quantitative traits is formed on a large scale, and the possibility of extensive selection in these hybrid populations is high [10, 11]. One of the main components of productivity is the weight of cotton per bag. The weight of cotton in one boll is a complex characteristic and depends on the number of bolls (the number of nests in the boll), the number and weight of the seed, and the fiber index. In the varieties of *G. hirsutum* L., the weight of cotton in one bag is mostly 5-10 grams. If varieties that differ sharply from each other in terms of the size of the cyst are crossed, the first generation hybrids occupy an intermediate position between the parental forms. When varieties with the same index of this sign are crossed, heterosis is often observed in F_1 hybrids. According to the size of the cup, the superiority of the hybrids over the parent form is shown by the increase of seed number, absolute weight or fiber index, or all of them change in unity. In the second term, separation occurs at the expense of quantitative signs, as a result of which an infinite series of variations is formed. At the same time, sorting in the F_2 and F_3 joints is extremely effective [4].

Productivity (cotton yield) is a more complex trait. Yield is determined by the number of bolls on a cotton plant and the weight of cotton per boll. At the same time, productivity depends on many other characteristics - for example, early maturity, resistance to diseases and pests, and the adaptability of the variety to the influence of changing environmental conditions. In the conditions of Central Asia, high-yielding varieties produce a large amount of bolls, but late-ripening varieties practically do not produce high yields, because the weight of boll cotton decreases sharply after severe frosts. High-yielding, but disease-resistant varieties have low productivity [4-7]. Quantitative characteristics of cotton include many important economic characteristics - fiber length, quantity and boll size. To evaluate such signs, it is necessary to measure, weigh, count them. A variation series is generated based on these measurements. Quantitative traits are polygenic, that is, the development of

the same trait is determined not by a pair of genes, but by several genes acting in the same way. Such genes are called polymeric genes. According to the theory of polymeric inheritance developed by Nilson-Elle, Emerson and Smith, the effect of polymeric genes is additive. Each active allele of genes contributes equally to the development of the trait. One of the most important features of polyheritance is that the character is intermediate in character without dominance in hybrids of the first generation [3-6, 9]. Boll fineness (the weight of cotton in one boll) is a complex characteristic and depends on the number of bolls (the number of nests in the boll), the number and weight of the seed, and the fiber index. Each of these characters is inherited independently of each other, and the weight of cotton per boll of a hybrid depends on the recombination of structural elements [1-5].

3 Results and discussion

Many of the economic properties of cotton are complex. They consist of some elements and emerge from the combination of several elements that show signs. The yield per boll consists of two main elements: the number and weight of bolls per plant. Productivity is determined in all nurseries, at the discretion of the breeder, in ten plants in each counting row. Usually the yield is counted until and after frost in September. This includes all cysts, open and unopened cysts, of all sizes and where they fall. The pods are calculated as follows: first, the crop elements located on the monopodial branches are counted and written; then those on all sympodial branches are numbered from first to last. To do this, the pods are counted while holding the first crop branch on the main stem, then climbing up to the second crop branch and counting the pods. In this way, it continues upwards along the stem from one branch to another. The left hand should be holding the stem at all times. Otherwise, you have to skip the sympodium or count the cells twice. Spills are also counted as such. Defoliated joints are easy to identify because the sympodium is located opposite each leaf. Instead of counting all retained crop elements, it is possible to count opened pods separately, large unopened pods separately, and small unopened pods separately.

The number of pods per plant is the main component of productivity, and based on the results of the variation index, positive and negative transgression, that is, the probability of the appearance of plants with large and small pods, is higher in complex hybrids. Therefore, special attention is paid to studying the heredity, variability and formation of this trait in genetic and selection research. In our experiments, the indicators of the number of bolls per plant in families and lines based on double and composite hybrids of cotton, the processes of formation of families and lines by character were analyzed (Table 1).

According to the data in the table, from the families obtained on the basis of double hybridization, O-31 (F_4 Tashkent-6 x Bukhara-6) had a relatively high result, which was 24.8 units. In the rest of the families in this block, it was noted that the indicator according to the sign was from 22.8 units to 24.10 units. It was shown that the amplitude of variation was from 26.10 % (O-26) to 28.11 % (O-28). F_4 Tashkent-6 x Bukhara-6, which is superior among the families based on double hybridization according to its origin, and the superiority of the family separated from the hybrid combinations of F_4 Zharkurgan x (F_1 Tashkent-6 x Bukhara-6) among the composite families the dominance of the composite O-3406 family was observed. In this family, the indicator for the character was 25.75 units, while in the rest of the families in this block, it was from 24.50 units (O-2757) to 25.30 units (O-3411). It was observed that the amplitude of variation ranged from 26.10 % (O-3411) to 26.80 % (O-3407) in composite families.

Table 1. Indicators on the number of bolls per plant in families and lines based on double and composite hybrids of cotton, pcs/1 plant (2020).

Families	Families come output	M $\pm$ m	s	V, %
Families obtained on the basis of pair hybridization				
O-28	F ₄ Jarkurgan x Gulistan	24.10 $\pm$ 1.9	5.2	28.11
O-27	F ₄ _ Jarkurgan x L-151	23.30 $\pm$ 1.8	5.8	27.25
O-25	F ₄ Sultan x Gulistan	22.80 $\pm$ 1.9	5.5	28.00
O-26	F ₄ Sultan x L-151	2370 $\pm$ 1.8	5.8	26.80
O-31	F ₄ Tashkent-6 x Bukhara-6	24.80 $\pm$ 1.9	4.9	26.10
Families derived from composite hybridization				
O-3411	F ₄ Jarkurgan x (F ₁ Jarkurgan x Gulistan)	25.30 $\pm$ 1.8	5.4	26.10
O-2757	F ₄ Jarkurgan x (F ₁ Jarkurgan x L-151)	24.50 $\pm$ 1.5	5.3	26.20
O-3398	F ₄ Jarkurgan x (F ₁ Sultan x Gulistan)	25.10 $\pm$ 1.7	5.2	25.50
O-3407	F ₄ _ Jarkurgan x (F ₁ Sultan x L-151)	24.52 $\pm$ 1.9	4.7	26.80
O-3406	F ₄ Jarkurgan x (F ₁ Tashkent-6 x Bukhara6)	25.75 $\pm$ 1.5	4.8	26.60
Created ridges				
T-3377	O-3398	26.5 $\pm$ 1.9	5.6	27.10
T-3378	O-3406	27.8 $\pm$ 1.9	6.7 _	21.25
T-3379	O-3411	26.9 $\pm$ 1.8	5.6 _	24.06
S-6524		26.15 $\pm$ 1.1	3.20	23.45
EKF 05		3.1		

During our research, we analyzed the lines created on the basis of the isolated families for all productivity elements. These generated ridges were noted to be at or above the standard grade S-6524 (26.15 units) in character. Among the ridges, the highest indicator was observed in the T-3378 ridge (27.80 units), with an advantage of 1.65 units. Good results were also shown in the rest of the ridges, it was 26.90 units in the T-3379 ridge and 26.70 units in the T-3377 ridge. It was shown that the amplitude of variation was from 21.25 % (T-3378) to 27.10 % (T-3377).

One of the main components of yield in a row is the index of cotton weight per boll, which is a polygenic trait. Boll fineness (the weight of cotton in one boll) is a complex characteristic and depends on the number of bolls (the number of nests in the boll), the number and weight of the seed, and the fiber index. Each of these characters is inherited

independently of each other, and the weight of cotton per boll of the hybrid depends on the recombination of structural elements. Industrial varieties differ in the weight of cotton per boll. *G. hirsutum* L. type in varieties one in the bag of cotton weight from 3 g to 8 - 10 grams will be [4].

According to the data of Table 2 in our research, in the families obtained on the basis of double hybridization, the result of 6.9 g was recorded in the O-31 family, which was slightly superior to the model variety S-6524 (6.13 g). It should be noted that this family also showed superiority in the number of pods per plant. This was considered to be the result of positive transgression from the first generations and the result of the correct choices made by the next generations in the separation of families.

Table 2. Indicators of cotton weight per boll in families and ranges based on double and composite hybrids of cotton, g (2020).

Families	Families come output	M ±m	s	V, %
Families obtained on the basis of pair hybridization				
O-28	F ₄ Jarkurgan x Gulistan	6.0 ± 0.47	1.00	5.75
O-27	F ₄ Jarkurgan x L-151	5.8 ± 0.75	1.11	5.20
O-25	F ₄ Sultan x Gulistan	5.9 ± 0.65	1.75	7.20
O-26	F ₄ Sultan x L-151	6.0 ± 0.40	1.50	6.30
O-31	F ₄ Tashkent-6 x Bukhara-6	6.9 ± 1.01	1.85	6.20
Families derived from composite hybridization				
O-3411	F ₄ Jarkurgan x (F ₁ Jarkurgan x Gulistan)	6.75 ± 0.70	1.70	5.14
O-2757	F ₄ Jarkurgan x (F ₁ Jarkurgan x L-151	6.63 ± 0.80	1.81	5.30
O-3398	F ₄ Jarkurgan x (F ₁ Sultan x Gulistan)	6.10 ± 1.30	1.49	5.90
O-3407	F ₄ Jarkurgan x (F ₁ Sultan x L-151)	6.25 ± 1.50	1.38	7.20
O-3406	F ₄ Jarkurgan x (F ₁ Tashkent-6 x Bukhara-6)	6.30 ± 0.80	1.20	6.75
Created ridges				
T-3377	O-3398	7.0 ± 0.55	1.8	3.90
T-3378	O-3406	7.1 ± 0.85	1.9	3.97
T-3379	O-3411	7.5 ± 0.75	1.8	3.93
S-6524		6.13 ± 0.56	1.2	3.35
EKF 05		2.7		

All of the families isolated on the basis of composite hybridization had a result above 6 grams, the superiority of the model variety S-6524 was seen. The highest value for the symbol is 6.75 grams, which was observed in the O-3411 family. In other families, it was shown that the indicator according to the sign was from 6.10 (O-3398) grams to 6.30 (O-3406) grams. All the families created on the basis of the above families showed superiority, and the results from 7 (T-3377) to 7.5 (T-3379) grams were recorded. Analysis of the amplitude of variation showed that in pairs and composite hybrids, it was mainly from 5% to 7%, and in ridges it was almost at the level of the model variety (3.35%), mainly up to 3.9%.

According to Table 3, the weight of 1000 seeds was analyzed in families and lines based on double and composite hybrids of cotton. Among the families obtained on the basis of pair hybridization, O-31 also prevailed in this respect and amounted to 125 grams. All of them showed an advantage of 2 to 7.5 grams compared to the S-6524 (117.5 g) variety, respectively 119.5 g in O-28 and 125 g in O-31. In families obtained on the basis of composite hybridization, the indicator for the character was in the range of 121.5 g (O-3411) to 125.9 g (O-3406). The 1000-seed weight of rows created on the basis of pairs and composite families was higher, ranging from 129.6 g to 131 g. This showed an advantage of 12.1 grams to 13.5 grams compared to the model S-6524 variety. The amplitude of variability was almost the same in all families and lines, it was 6% - 6.89%, and it was 4.42% in the sample S-6524 variety.

Table 3. Indicators of weight of 1000 seeds in families and ridges based on double and composite hybrids of cotton, g, (2020).

Families	Families come output	M ±m	s	V, %
Families obtained on the basis of pair hybridization				
O-28	F ₄ Jarkurgan x Gulistan	119.5 ±1.9	1.59	6.50
O-27	F ₄ Jarkurgan x L-151	120.0 ±1.8	1.15	6.92
O-25	F ₄ Sultan x Gulistan	121.3 ±1.4	2.40	6.20
O-26	F ₄ Sultan x L-151	123.5 ± 2.2	3.60	6.30
O-31	F ₄ Tashkent-6 x Bukhara-6	125.0±1.2	3.80	6.62
Families derived from composite hybridization				
O-3411	F ₄ Jarkurgan x (F ₁ Jarkurgan x Gulistan)	121.5 ±1.8	1.90	6.56
O-2757	F ₄ Jarkurgan x (F ₁ Jarkurgan x L-151	123.0±1.5	1.45	6.89
O-3398	F ₄ Jarkurgan x (F ₁ Sultan x Gulistan)	123.5±1.8	1.65	6.50
O-3407	F ₄ Jarkurgan x (F ₁ Sultan x L-151)	121.8 ±1.7	1.60	6.78
O-3406	F ₄ Jarkurgan x (F ₁ Tashkent-6 x Bukhara-6)	125.9 ±1.9	1.77	6.80
Created ridges				
T-3377	O-3398	130.0 ±1.9	1.5	6.85
T-3378	O-3406	129.6 ±1.8	1.3	6.45
T-3379	O-3411	131.0 ±1.7	1.8	6.78
S-6524		117.5±1.8	1.1	4.42
EKF 05		2.9		

From the components of the productivity, the productivity of the families obtained on the basis of double hybridization is shown in the family O-31 (140.4 g/plant), and the model S-6524 (132 g/plant) is 8.4 g/plant. advantage was shown. In the rest of the families, the indicator for this sign is 130.1 (O-28) g/plant. from 140.3 (O-27) g/plant was between Among the families obtained on the basis of composite hybridization, the highest index was shown in the O-3406 family, which was 165.2 g/plant. High results were recorded in other families, from 150 (O-3411, O-3398) g/plant to 160.5 (O-3407) g/plant. All the established

lines had high productivity values, ranging from 169 g/plant to 175 g/plant. results up to Fluctuation of the amplitude of variation in productivity was higher than 7% in all families, higher than 6% in ridges and 5.49% in the model variety (Table 4).

Table 4. Productivity index in families and lines based on double and composite hybrids of cotton, g/plant (2020).

Families	Families come output	M ±m	s	V, %
Families obtained on the basis of pair hybridization				
O-28	F ₄ Jarkurgan x Gulistan	130.1 ±1.5	1.55	7.78
O-27	F ₄ Jarkurgan x L-151	140.3 ±1.7	1.76	7.79
O-25	F ₄ Sultan x Gulistan	140.0±1.9	1.90	7.80
O-26	F ₄ Sultan x L-151	139.9 ±1.7	1.50	7.85
O-31	F ₄ Tashkent-6 x Bukhara-6	10.4 ±1.9	1.85	7.82
Families derived from composite hybridization				
O-3411	F ₄ Jarkurgan x (F ₁ Jarkurgan x Gulistan)	150.0 ±1.9	1.55	8.10
O-2757	F ₄ Jarkurgan x (F ₁ Jarkurgan x L-151	160.0 ±1.4	1.80	7.50
O-3398	F ₄ Jarkurgan x (F ₁ Sultan x Gulistan)	150.0±1.9	1.40	7.10
O-3407	F ₄ Jarkurgan x (F ₁ Sultan x L-151)	160.5 ±1.7	1.30	7.80
O-3406	F ₄ Jarkurgan x (F ₁ Tashkent-6 x Bukhara-6)	165.2±1.5	1.30	7.80
Created ridges				
T-3377	O-3398	169.0±1.7	1.75	6.60
T-3378	O-3406	170.5±1.5	1.30	6.70
T-3379	O-3411	175.0±1.7	1.45	6.80
S-6524		132.0 ±1.8	1.26	5.49
EKF 05		2.8		

4 Conclusions

The text highlights the significance of certain cotton families and lines in improving productivity. It suggests that the O-31 and O-3406 families, along with the T-3378 line, exhibit high boll counts per plant, while the O-31 and O-3411 families, along with the T-3379 line, have high cotton weight per boll. Additionally, the O-31 and O-3406 families, along with the T-3379 line, are advisable for use in terms of seed weight index. Selecting appropriate parental pairs and utilizing composite hybridization can aid in creating new cotton varieties and improving productivity. The text emphasizes the use of the O-3406, O-3407, O-3398, O-3411, and O-2757 families, as well as the established T-3377, T-3378, and T-3379 lines, to achieve positive results in the creation of productive cotton varieties.

To improve the readability of the text, it could be rephrased as follows:
This text underscores the importance of specific cotton families and lines in enhancing productivity. The O-31 and O-3406 families, in addition to the T-3378 line, demonstrate elevated boll counts per plant, while the O-31 and O-3411 families, along with the T-3379 line, exhibit increased cotton weight per boll. Moreover, for seed weight index, the O-31

and O-3406 families, as well as the T-3379 line, are the recommended choices. Effective selection of parental pairs and utilization of composite hybridization can aid in creating new cotton varieties and improving productivity. It is particularly effective to use the O-3406, O-3407, O-3398, O-3411, and O-2757 families, as well as the established T-3377, T-3378, and T-3379 lines, to achieve desirable results in creating productive cotton varieties.

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