



Available Online at ESci Journals
Journal of Plant Breeding and Genetics

ISSN: 2305-297X (Online), 2308-121X (Print)
<http://www.escijournals.net/JPBG>



CREATION OF PRODUCTIVE LINES OF COTTON BASED ON INTROGRESSIVE FORM OBTAINED WITH PARTICIPATION OF THE WILD DIPLOID SPECIES *G. TRILOBUM SKOVSTED*

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ABSTRACT

The results of use of introgressive form L-T F₁₅BC₄ (*G.hirsutum* L., the variety C-4727 x *G.trilobum Skovsted*) x C-4727, obtained with the participation of wild diploid species *G.trilobum Skovsted*, in the creation of new lines (F₉-F₁₀) of upland cotton with enriched genetic basis, are presented. The new lines are characterized by high resistance to *Verticillium dahliae* Kleb., high fiber quality and increased productivity in comparison with standard varieties.

Keywords: cotton, *G.trilobum Skovsted*, introgressive form, resistance to *Verticillium dahliae* Kleb.

INTRODUCTION

As it is known, wild diploid species of cotton possess high resistance towards diseases and pests (Alikhodjayeva *et al.*, 1992; Ter-Avanesyan, 1973). They are a valuable source of germplasm necessary for breeders for breeding new cotton varieties.

Though the potential of such diploid species is not enough used in the breeding programs, and that is related to the difficult crossing of distant species and sterility of obtained hybrids. As a result, the limited use of rich gene pool of species leads to genetic uniformity of varieties, and that has a negative impact on plants immunity. By crossing of wild diploid species of cotton *G.trilobum Skovsted* (2n=26) with natural tetraploid *G.hirsutum* L., the variety C-4727 (2n=52), the triploid hybrid (2n=39) had been obtained (Semenikhina *et al.*, 1979) (see scheme). Then by processing of point of increase of actively growing bines of sterile triploid with 0.1% dilution of C, the productive hexaploid amphidiploids *G.hirsutum* L., the variety C-4727 x *G.trilobum Skovsted* (2n=78) were induced. The induced amphidiploids had inherited the features of parental forms and turned out to be highly resistant towards

Verticillium Wilt. Though, hexaploid amphidiploids, as well as their diploid parent, turned out to be strictly photo periodic. Besides, they had limited number of small bolls, and their fiber length and output did not correspond to the requirements of light industry standards. With the objective to improve economically-valuable characteristics of amphidiploid in further breeding work, it's four times backcrossing with recurrent variety C-4727 was carried out.

Thus, on the basis of the crossing of the cultivated type S-4727 with the wild diploid form *G. trilobum Skovsted* we obtained the introgressive form F₁₅BC₄ (*G.hirsutum* L., the variety S -4727 X *G.trilobum Skovsted*) X S-4727, resistant to *Verticillium dahliae* and which is characterized by the high-quality fiber.

For the purpose of an increase in the economically valuable signs introgressive form L- T in 2001. Again, it was back-crossed with the big-boll type of cotton plant Omad (*G.hirsutum* L.).The objective of study: Creation of wilt resistant, highly productive breeding lines of cotton, with increased output of qualitative fiber, on the basis of the crossing of introgressive form L-T and the variety Omad.

MATERIALS AND METHODS

The experiments were carried out in 2010-2011 in National cotton breeding and the seed production

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research institute Republic of Uzbekistan in 5 kilometres to the north-east from Tashkent. The weather conditions during the period of carrying out the experiments were close to average multiyear. Planting of seeds was carried out on the naturally infected background of *Verticillium dahliae* Kleb. In optimal terms, the scheme of planting 60 cm x 20 cm x 1 plant.

As the material for the study the lines (F₉-F₁₀), obtained in the result of the crossing of introgressive form L-T F₁₅BC₄ (*G.hirsutum* L., the variety C-4727 x *G.trilobum* Skovsted) x C-4727 and the variety Omad (*G.hirsutum* L.), were served. 8 lines, each with 100-120 plants, had been studied, as the standard ones were served the varieties Namangan -77 and C-6524.

The assessment of plant affection with *Verticillium wilt* was carried out in the end of vegetation according to cut off stalk near root collar according to the methodology of Dobrovolsky,1969.

In order to define the weight of raw cotton of one boll, fiber length and output we collected coupons of 25 bolls from the first internodes of the second and the third sympodial branches. In laboratory conditions, we defined the weight of raw cotton of one boll by dividing of the total weight of raw cotton into the number of bolls. Fiber output is the ratio of obtained fiber towards raw cotton expressed in percentage. The date was subject to statistic processing according to the methodology of Dospekhov,1969. The analysis of fiber quality was defined on High Volume Instrument (HVI) equipment.

RESULTS

In the result of multiyear selections on wilt backgrounds, we obtained introgressive forms with euploid (2n=52) number of chromosomes. They combined characteristics of tetraploid species and properties of *G.trilobum* Skovsted: high metric number and strength of the fiber, resistance towards *Verticillium* Wilt. Among those, the special interest represented introgressive form L-T – F₁₅BC₄ (*G.hirsutum* L. the variety C-4727 x *G.trilobum* Skovsted) x C-4727. It was characterized by high resistance towards *Verticillium* wilt in comparison with

parental form C-4727 and cultivated varieties of cotton. That form possessed high fiber quality (Semenikhina *et al.*, 1979). Though, the plants were late ripening, bolls and seeds of that form according to the sizes conceded to the indices of cultivated varieties. In this connection, we exposed that introgressive form to backcross for the 5-th time will bigger bolls variety Omad and subsequent pedigree selections within 10 years.

Among the selections among hybrids, we had bred a number of lines with enriched genetic structure. Let's give characteristics of some of them that had been studied in 2010-2011 (Table 1).

The most premature were the lines Л-244, Л-248 and Л-250: they were ripening approximately for the period of 110-111 days, and that is for 3-3.5 days shorter than with standard ones. With the other lines, the duration of the vegetative period was from 111.3 (the line L-249) to 116.3 (the line L-247) days. In comparison with the previous year in 2011, the duration of the vegetative period of the new lines was for 4-10 days shorter. The above mentioned lines were ripening for about 102-107 days. The standard varieties Namangan-77 and C-6524 were ripening, respectively, for 107 and 105 days.

In 2010 among studied in control nursery lines of cotton, the best ones according to the mass of raw cotton of one boll were the lines: L-241 (7.2 gr.), L-244 (6.8 gr.) and L-250 (6.5 gr.). With the other lines that index was within 5.8 - 6.4 gr. (Table 1). In F₁₀ the highest indices on that characteristics were observed with the lines L-249 (8.0 gr.) and L-248 (6.2 gr.).

The mass of 1000 pieces of seeds with tested lines in F₉ was equal to 120-140 grams. The exclusion was the line L-244 (110 gr.). With the majority of lines in 2011, the subject index was equal to 130-135 grams.

The tested lines in 2011 had the output of fiber from 37.5 to 43.7%. With six lines that index exceeded or was equal to 40% (Table 1).

Introgressive forms of interspecific origin play not the least of the role in the improvement of the genotype of upland cotton varieties according to fiber quality.

Table 1. Indices of economically-valuable characteristics of new lines of cotton (2010-2011 rr.).

Standard varieties and line	the weight of boll, (gr)		the weight of 1000 seeds, (gr)		G.T.O. (%)		Len, inch		Str, g/tex		Mic		Maturity, days	
	2010 r.	2011 r.	2010 r.	2011 r.	2010 r.	2011 r.	2010 r.	2011 r.	2010 r.	2011 r.	2010 r.	2011 r.	2010 r.	2011 r.
	St. Namangan - 77	6.2	6.0	130	130	36.1	37.3	1.16	1.11	31.5	28.8	4.9	5.3	113.5
St. C-6524	6.1	6.1	140	138	36.2	38.1	1.20	1.14	33.0	33.8	4.6	5.1	113.1	105.5
L-241	7.2	6.5	140	130	36.7	40.4	1.29	1.27	35.4	34.4	4.1	4.6	113.8	106.1
L-243	5.8	5.6	120	130	37.6	39.7	1.19	1.16	32.4	33.9	4.3	4.4	114.1	102.9
L-244	6.4	6.4	110	136	39.3	41.4	1.27	1.22	34.8	33.8	4.2	4.4	110.0	102.7
L-247	6.8	6.4	130	134	40.3	43.3	1.27	1.22	35.4	31.8	4.4	4.9	116.3	105.5
L-248	6.2	7.1	130	128	39.7	42.8	1.27	1.27	33.7	34.5	4.6	4.9	110.7	106.7
L-249	6.0	8.0	120	140	37.3	37.5	1.14	1.23	32.0	33.0	4.5	4.8	111.3	107.3
L-250	6.5	6.3	120	130	40.8	41.6	1.23	1.22	32.4	32.8	5.0	5.1	110.8	103.8
L-251	6.4	6.4	120	135	37.3	43.7	1.18	1.18	33.2	37.0	4.3	4.9	112.6	102.4

As it is shown in Table 1 in 2010, except the line L-250, all the others tested lines had optimal microneire from 4.2 to 4.6. With standard varieties, microneire was equal to 4.9 with the variety Namangan - 77 and 4.6 with C-6524. The indices of fiber specific breaking load are within 32.0 – 35.3 g/tex, i.e. the fiber breaking load of those lines is characterized as very high. Except for the line L-249, a fiber length of which was equal to 1.14 inch, the indices of fiber length of new lines of cotton in 2010 was high. Four lines the fiber length of which was equal to 1.22, 1.23 inch is referred to industrial type 3 and 2 lines with a fiber length of 1.27 inch are referred to industrial type 1 (Table 1). This witness about the high quality of fiber of the new lines that are approaching the indices of long-fiber cotton.

It should be noted that in 2011 the abnormally hot summer had led to the early accumulation of efficient

temperatures sum and, as a consequence, to the more earlier maturation of plants of cotton. That had led, apparently, to some increase of fiber microneire.

We carried out the assessment of the new lines for their resistance towards verticillium wilt (*Verticillium dahliae* Kleb.). The most resistant were the lines: L-241, L-243, L-244, L-247, L-248 and L-251, their plants were not affected in a strong degree, and in total were affected from 1.9 to 9.4% of plants (Table 2). The standard variety Namangan - 77 was affected for 28.8% in a strong degree, and in total for 48.0%; the variety C-6524 was affected for 16.9% in a strong degree, and in total for 35.7%. The resistance towards verticillium wilt and increased fiber quality, in our view, is the result of involvement in the crossing of introgressive form with the participation of *G.trilobum* Skovsted.

Table 2. The affection of new lines of cotton with Verticillium wilt (2011r.).

№ of line	n	Degree of affection according to cut of root collar, %	
		strong	general
St. Namangan- 77	120	28.8	48.0
St. C-6524	116	16.9	35.7
L-241	90	0	0
L-243	85	0	1.9
L-244	80	0	6.9
L-247	72	0	8.7
L-248	77	0	6.7
L-249	67	0	20.0
L-250	67	2.1	9.4
L-251	72	0	2.5

In 2010 the line L-243, among 8 selected lines, on naturally infected background with wilt was the most productive in average 47.8 centners/ha (Table 3). The lines L-250, L-244, L-241 had the productivity above 40 centners/ha. At the same time, the yield of standard variety Namangan-77 was reaching 31.5 centners/ha,

and the variety C-6524 – 34.4 centner/ha. The present new lines were obtained with the participation of introgressive form L-T and the variety Omad. The line L-243 was characterized by the highest resistance towards Verticillium wilt and fiber quality of types III-IV.

Table 3. Comparative yields of new lines and standard varieties (2010), (centner/ha).

№	№ of line	Replication				Average cent./ha	Deviation from standard	
		I	II	III	IV		cent./ha	%
1	L-250	43.1	44.5	45.3	41.2	43.5	9.1	26.4
2	L-244	43.8	43.2	42.5	42.9	43.1	8.7	25.3
3	L-241	41.2	43.4	42.7	40.1	41.8	7.4	21.5
4	L-243	48.4	48.7	47.7	46.4	47.8	13.4	38.9
5	L-247	39.5	40.6	41.7	41.1	40.7	6.3	18.3
6	L-248	29.7	33.5	31.3	34.7	32.3	-2.1	-6.1
7	L-249	31.7	29.1	30.9	29.0	30.1	-4.3	-12.5
8	L-251	29.5	30.7	31.7	27.4	29.8	-4.6	-13.3
9	St. Namangan-77	32.5	31.7	31.2	30.8	31.5	-2.9	-8.4
10	St. C-6524	33.8	33.2	32.5	34.3	34.4	-	-

LSD_(0.5) = 1.89

DISCUSSION

Resistance to verticillium wilt is the most important sign of the contemporary industrial type of cotton plant. At present, as a result, the creation of new, steadier, more tolerant selective types the damage, applied by wilt to the harvest of raw cotton, to the quality of fiber and seeds became less; however, the experience of past years proves the need for continuing experiences on the creation of new steady types. It is not possible to increase wilt resistance of cotton plant only by the methods of inter varieties hybridization. In connection with this the need for further studies on the systematic involvement in the program of the selection of the new donors of stability with application and improvement of the methods of the remote hybridization appears, taking into account the fact that cotton plant it is characterized by a lot of forms and by the polymorphism of signs in the limits of form. The latter testifies about the enormous reserves for the remote interspecies hybridization with the participation not only of the polyploid but also wild diploid forms of the cotton plant (Beasley and Brown, 2000; Brubaker *et al.*, 2000; Patel and Thacar, 1950, Rizaeva, 1996; Shakhmedova, 2003; Thombre and Mehetre, 1981).

Unlike cultivated species, many wild species of cotton

possess dominant genes of resistance towards diseases. Wild species are characterized also by strong fiber, early maturation with optimal conditions for plant development, resistance towards gummosis, nematodes, arachnoidal mite, aphids, boll worms, billbug and etc. (Don *et al.*, 2007; Meyer, 1972; Nilesh *et al.*, 2013; Rammachandran *et al.*, 1964). Many of the listed characteristics are absent or weakly expressed with cultivated species. Wild diploid species of cotton *G.trilobum Skovsted* (according to classification of Mauer, 1954) is characterized by dominant resistance towards natural populations of the fungus *V.dahliae Kleb.*, and also has a number of other advantages (Alikhodjayeva *et al.*, 1992; Makhmudov, 1979; Smith, 1957). Thus we used it in the breeding programs.

We have detected that with the crossing of introgressive form with premature and larger bolls variety Omad (*G.hirsutum L.*), the hybrid generation possesses characteristics that are absent with the partner on hybridization, and this extends the possibility for selection of valuable forms. It should be noted that introgressive form contains known a number of alien genes of wild species that provide undesirable characteristics, for instance, such as smaller balls. The carried out by us additional hybridization allowed, with

broad enough scale of the experiments, to select unique transgressive segregants. The new lines turned out to be resistant towards Verticillium wilt, highly productive, with the optimal combination of economically-valuable characteristics and properties. They combine in their genotype the best characteristics of cultivated variety and introgressive form L-T. The new lines form larger bolls, in comparison with standard varieties, they are characterized by high enough fiber output, and they possess optimal micronaire and unique indices of specific strength and fiber length. Thus, on the bases of elaborated by us methodology, we obtained families and lines on the new genetic basis, that predominate standard varieties according to the complex of characteristics and properties.

CONCLUSIONS

It is detected that the introgressive form L-T F₁₅BC₄ (*G.hirsutum L., the variety C-4727 x G.trilobum Skovsted*) x

C-4727 is the donor of resistance towards Verticillium wilt and high fiber quality.

The efficiency of crossing the introgressive form L-T with the variety Omad in the creation of valuable breeding lines of cotton has been proved. The obtained lines L-250, L-244, L-241, L-243, L-247, L-249, L-251 possess the complex of economically-valuable characteristics, especially high wilt resistance and unique indices of fiber quality.

While comparing yields of standard variety with the bred new lines it has been detected that the latter possess advantage according to those characteristics.

The high productivity of line L- T x Omad is explained by larger box, mass 1000 pieces of seeds and by the stability of plants to the verticilliose disease.

The Scheme for Obtaining of New Varieties and Lines of Cotton on the Basis of Crossing of Cultivated Species *G.hirsutum L.* with Wild Diploid Species *G. trilobum Skovsted*.

Crossing <i>G. hisutum L., the variety C-4227 (2n=52) x G. trilobum Skovsted (2n=26)</i>	
Amphihaploid F1 (2n=39)	The sum of chromosomes of two haploids. The plant is sterile.
Doubling of chromosome number of amphihaploid by C-tumor of the point of growth of germs and obtaining of amphidiploids (2n=78).	The sum of chromosomes of two diploids. The plants are fruitful, wilt resistant, with late maturation.
1-st backcrossing of amphidiploids with the variety C-4727. Selection of wilt resistant, cultural type plants.	Pentaploids (2n=65). The plants are fruitful, wilt resistant, with average maturation.
2-nd backcrossing of pentadiploid with the variety C-4727. Selection of wilt resistant highly productive plants.	The plants are fruitful, wilt resistant, with different number of chromosomes (2n=52; 2n=54; 2n=58) and the others.
3-rd backcrossing of hybrids with the variety C-4727. Carrying out selection according to the complex of characteristics.	The plants are highly fruitful, premature, wilt resistant, a number of chromosomes 2n=52.
4-the backcrossing of hybrids with the variety C-4727. Carrying out selection according to the complex of characteristics.	The families are highly fruitful, wilt resistant and premature, with increase fiber quality.
Multiyear selections of the best plants and families	Introgressive form L-T and families biologically active, wilt-resistant with quality fiber.
5-the backcrossing of the form L-T with larger boll variety of cotton of the species <i>G. hirsutum L.</i> Multiyear selections of wilt resistant plants and families strongly affected by the fungus <i>V.dahliae Kleb</i> , in the soil.	New highly fruitful, complex valuable and complex resistant lines and varieties of cotton with increased output of quality fiber.

REFERENCES

Alikhodjayeva S.S., Munasov Kh, Muratov U.M. 1992, Wild and ruderal forms of cotton of the species *Gossypium hirsutum L.* Tashkent: University, 60 pp.

Beasley J.G., Brown M.S. 1943. The production of plants having on extra pair of chromosomes from species hybrids of cotton. Records genet. Soc. Am. № 12. P.43.

- Brubaker C.L., Brown A.H.D., Grace J.P., Kilby M. J. Cotton. 2000. ICAC 59th plenary Meeting Cairns, Australia, p. 619-624.
- Dobrovolsky B.V. 1969. Methodological guidelines on survey of cotton plantings for affection with wilt. p. 5.
- Don C. Jones, Fred Borland, Keiser A.R. Notice of release of three Arcot S23 germplasm lines of cotton. Beltwide cotton conferences, New Orleans, Louisiana, January 9-12, 2007. p. 6404.
- Dospekhov B.A. Methodology of field experiment. M.: Kolos, 1979. p. 416.
- Makhmudov T.K. Reciprocal amphidiploids in breeding //Cotton breeding. 1979. №3. pp.23-24.
- Mauer F.M. Cotton. Origin and systematics, in 4 volumes // Tashkent; 1954. - V.1. p. 381.
- Meyer V.G. Citoplasmic effects on other numbers in interspecific hybrids of cotton *G. longicalyx* Heredity // 1972. V. 63. № 1. P. 33-34.
- Nilesh D. Dighe, A. Forest Robinson, Aloise A. Bell et. al. Early-generation breeding results from genomewide introgression of *G.longicalix* and *G.armorianum* germplasm. Beltwide cotton conferences, Nashville Tennessee, January 8-11, 2008, p.p. 819-820.
- Patel G.B., Thacar B. J. Cotton improvement thought interspecific hybridization. Indian cotton Grow Rew, 1950. V. 4. P. 185-198.
- Rammachandran S.K., Krishnamurtu T., Patel G. Percent advances in interspecific hybridization work involving wild species of cotton in Madras. Indian Cotton Grow. Rev. 1964. V. 18. № 4. P. 248-257.
- Rizaeva S. M. Remote hybridization of cotton and obtaining new donors: Author's abstract, Dissertation of Doctor of Biological Sciences, Tashkent, 1996. P. 48.
- Semenikhina L.V., Egamberdiev A.E., Gurevich L.I. Appearance of contrast characteristics with cotton hybrids F1 and amphidiploids K1, K2 //Genetics - M., 1979. - V.15. - № 11.- pp. 2013-2016.
- Shakhmedova G.S. Selective value of worldwide diversity of cotton generation (*Gossypium L.*): Author's abstract, Dissertation of Doctor of Biological Sciences. Saint-Petersburg: VIR, 2003. p. 42.
- Smith A.L. Report of verticillium wilt committee. Proc. of the cotton disease council.1957. P. 6.
- Ter-Avanesyan D.V. Cotton, M. Kolos, 1973. p. 478. In: Beasley J.G., Brown M.S. The production of plants having on extra pair of chromosomes from species hybrids of cotton. Records genet. Soc. Am.1943. № 12. P.43.
- Thombre M. V., Mehetre S. S. Interspecific hybridization in *Gossypium L.* Cytomorphological studies in haploid ($2n = 2x = 26: Ah Dx$) x *G. thurberi* ($2n = 26: DD$). // Cytology. 1981. V. 46. № 1. P. 291-299.