

To the Genetics of the Wilt-Resistant of Cotton

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Abstract: *The data suggest that in the genotypes of allotetraploidal parental varieties KS-1, AN-14 (*G. hirsutum* L.), there are recessive alleles of wilt-resistant genes, and for the introgressive baseline IL-296, IL-1378, IL-32 developed with the participation of the wild diploid cotton species *G.trilobum* Skovsted, there are dominant wilt-resistant genes.*

Keywords: Cotton, hybridization, verticillium wilt, wilt-resistance, genotype, reciprocal hybrids, recessive genes, dominant genes

1. Introduction

Wilt is one of the most dangerous diseases of cotton. Even relatively resistant to this disease varieties with a strong infection lose from 1/4 to 1/2 yield, susceptible varieties almost completely die or give an insignificant harvest of raw cotton of poor quality. The developing of wilt-resistant varieties is one of the most important and priority tasks of cotton breeding.

Widespread in the cotton zone of the verticillium wilt and the significant damage caused to them, necessitates a comprehensive study of this disease.

Over the last few years, with wide distribution of wilt in all cotton-growing countries, it became evident that almost all high-value cotton varieties of the species *G. hirsutum* L., developed by hybridization between cultural forms, possessing some degree of resistance, are generally not resistant to verticillium wilt and in the years, a massive outbreak of disease, they are greatly affected. The most resistant, as studies showed (1, 2, 3, 4), were the varieties created by using interspecies hybridization.

To further develop the selection for resistance, extensive studies are needed to study the source material in the varietal and species profiles, inherit the sign of resistance in various close and remote crosses in order to develop methods of breeding for resistance and the developing of new gene pool.

2. Material and methods

The object of the investigation were synthetic introgressive lines and cultivars developed with the participation of wild diploid ($2n = 26$) species *G.trilobum* Skovsted and tetraploid species ($2n = 52$) *G. hirsutum* L.

The IL-296 line is selected in F_4 from a hybrid combination of crossing [*G. hirsutum* L., variety C-4727 x (AD *G.hirsutum* L. variety C-4727 x *G.trilobum* Skovsted)].

The IL 1378 line is selected in F_5 from a hybrid combination of crossing [AD *G.hirsutum* L. variety C-4727 x *G.trilobum* Skovsted) x *G.hirsutum* L. Tashkent)].

The IL-32 line is selected in F_5 from a hybrid combination of crossing [(AD *G.hirsutum* L., variety C-4727 x *G.trilobum* Skovsted) x *G.hirsutum* L variety C-4727].

The variety of cotton is KC-1. It was developed by the method of crossing the radio mutant M-281 with cultivated wilt-resistant variety Tashkent-6.

A variety of cotton AN-14. The variety was derived by crossing the radio mutant M-29 with the wild species *G.hirsutum* L. *ssp.mexicanum* (Tod.). By way of repeated backcrossing with the M-281 mutant line, an AN-14 strain was developed.

The investigations were carried out according to the evaluation of the resistant of the studied cotton forms to the wilt.

A hybrid analysis was used, an evaluation on a naturally severely infected infectious background, a static analysis.

3. Results of investigations

One of the essential factors that determine the positive heterosis in the crop of interspecies cotton hybrids is their wilt resistance.

In order to characterize the interspecies hybrids, the studies were carried out on an artificially infected wilt background together with the parent varieties. The sowing was carried out with single-row 20 plots in a 3 replication by the randomized blocks. Controlling of wilt was held on 15. IX. on a 4-point scale (table 1).

The obtained results of the research allow us to believe that recessive genes of wilt-resistance are present in the genotype of the allotetraploid parent cotton varieties KS-1 and AN-14, and in the introgressive initial lines IL-298, IL-1378, IL-32, which were developed with the participation of wild diploid specie cotton *G.trilobum* Srovsted, there are dominant genes inherited from the wild parent.

Parent cotton varieties KS-1, AN-14 were affected with a verticillium wilt at a low degree of 20.7 %, and 28.2 %, in the average degree of 35.9 % and 23.1%, a strong 32.4 % and 38,0 % of plants. The number of healthy plants did not exceed 11.1% for variety KS-1 and 10.2% for AN-14.

Table 1: Wilt-resistance of parent forms and reciprocal hybrids of cotton's first generation

Source parents and hybrids of F1 cotton	Number of account plants piece	Degree of affection with a verticillium wilt							
		Healthy plants I (0)		Slightly affected II		Medium affected III		Severely affected IV	
		piece	%	piece	%	piece	%	piece	%
KS-1	145	16	11,1	30	20,7	52	35,9	47	32,4
AN-14	139	15	10,2	39	28,2	32	23,1	53	38,0
IL-296	141	86	61	38	26,8	17	12,2	-	-
IL-1378	133	89	66,7	32	24,2	12	9,1	-	-
IL-32	137	67	48,7	44	32,4	26	18,9	-	-
IL-296 x KS-1	445	267	60,0	109	24,4	69	15,6	-	-
KS-1 x IL-296	441	247	56,1	129	29,3	65	14,6	-	-
IL-296 x AN-14	448	289	64,6	75	16,7	84	18,6	-	-
AN-14 x IL-296	443	258	58,1	100	22,5	82	18,6	3	0,68
IL-1378 x KS-1	440	264	60,0	99	22,5	77	17,5	-	-
KS-1 x IL-1378	446	251	56,2	117	26,1	70	15,7	7	1,57
IL-1378 x AN-14	444	282	63,6	101	22,7	61	13,7	-	-
AN-14 x IL-1378	448	243	54,2	131	29,2	70	15,8	4	0,89
IL-32 x KS-1	444	252	56,8	121	27,3	71	15,9	-	-
KS-1 x IL-32	440	253	57,5	110	25,0	70	15,9	7	1,6
IL-32 x AN-14	442	221	50,0	147	33,3	74	16,7	-	-
AN-14 x IL-32	440	242	55,0	132	30,0	56	12,7	10	2,72

In plants of the introgressive parental line IL-296, 61.0 % of the plants were completely healthy, slightly affected - 26.8 %, medium affected with 12.2 %. A similar result was noted in the introgressive lines IL-1378 and IL-32. In plants of reciprocal hybrids of the first generation, there was no uniformity in the manifestation of resistance to the verticillium wilt, which is probably due to the heterogeneity of the varietal population. The sensitivity of the reciprocal hybrids to the wilt varied slightly from 16.7 to 33.3 %, from 13.7 % to 18.7 % in the average degree, and there were no plants with a strong degree of defeat in wilt. In the hybrid combination of the first generation IL-296 x KS-1 from the examined 445 pcs. 60 % of plants were completely healthy, 24.4 % of plants were affected in a weak 15.6 % in medium degree. About the same picture was observed with the reverse crossing.

The sign of high wilt-resistance of introgressive parental cotton forms predominates in the subsequent hybrid combinations of reciprocal hybrids in F₁.

In plants of the first generation, in terms of stability, to a certain extent, there is a maternal effect. In those hybrid combinations where the maternal form is not a resistant

parent, the progeny appear in plant forms with a small percentage of severely affected plants (Table 1).

It should also be emphasized that, in the first hybrid generation, the quantitative spectrum of the sign of the wilt-resistance in 5 hybrid combinations (IL-296 x AN-14, IL-32 x KS-1, KS-1 x IL-32, IL-32 x AN -14; AN-14 x IL-32) exceeded the wilt-resistance of introgressive parent forms, the remaining 7 hybrid combinations occupied an intermediate position.

In a hybrid population of F₂ selected plants with slightly affected by wilt were obtained. Wherein in reciprocal hybrids of the second generation proportion of the wilt-resistant recombinants slightly increases, in comparison with reciprocal plants F₁, which attests on strengthening of the sign of wilt-resistance in F₂.

From a plant population F₂ were selected sick in different degree and absolutely healthy plants, and, the last ones in much larger quantities. For reciprocal hybrid combinations of second generation relates positive transgression, except hybrid combination KS-1 and IL -1378 (table 2.).

Table 2: Wilt-resistance of the parental forms and reciprocal hybrids of the cotton of the second generation

Source parents and hybrids cotton F ₂	Total accounted plants	Degree of defeat with a verticillium wilt							
		Healthy plants I (0)		Slightly affected II		Medium affected III		Severely affected IV	
		Thing	%	thing	%	thing	%	thing	%
KS-1	783	31	3,9	93	11,9	187	23,9	472	60,3
AN-14	679	28	4,1	113	16,6	168	24,8	370	54,5
IL-296	807	726	94,9	31	3,8	10	1,2	-	-
IL-1378	765	733	95,8	21	2,8	11	1,4	-	-
IL-32	811	774	95,4	24	3,0	13	1,6	-	-
IL-296 x KS-1	1424	997	70,0	173	12,1	138	9,7	116	8,1
KS-1 x IL-296	1408	977	69,4	235	16,7	117	8,3	79	5,6
IL-296 x AN-14	1420	983	69,2	178	12,5	153	10,8	106	7,5
AN-14 x IL-296	1408	925	65,7	209	14,8	156	11,1	110	8,4
IL-1378 x KS-1	1412	970	68,7	227	16,1	126	8,9	89	6,3
KS-1 x IL-1378	1414	930	65,8	236	16,7	149	10,5	99	7,0
IL-1378 x AN-14	1414	980	69,3	198	14,0	137	9,7	99	7,0
AN-14 x IL-1378	1422	967	68,0	209	14,7	140	9,8	106	7,4
IL-32 x KS-1	1412	908	64,3	253	17,9	126	8,9	125	8,9

KS-1 x IL-32	1410	884	62,8	231	16,4	179	12,7	116	8,2
IL-32 x AN-14	1425	866	60,8	285	20,0	148	10,4	126	8,8
AN-14 x IL-32	1420	863	60,8	249	17,5	189	13,3	119	8,4

In the second generation wilt-resistance of 11 reciprocal hybrid combinations by wilt-resistance, exceed introgressive parent forms and only hybrid combination F2 (KS-1 x IL -1378) wilt-stability was below the introgressive parent IL-1378.

On the basis of genetic analysis data one can conclude, that participating in hybridization varieties KS-1 A-14 for to

introgressive lines differ allelic two non-allelic and in F₂ (splitting is observed, characteristic of digene cumulative polymorphism).

Based on the results of the study third generation more inclined to indicators of resistant parental forms cotton (table 3.).

Table 3: Wilt-resistance of parent forms and reciprocal hybrids of cotton's third generation

Source parents and hybrids of F3 cotton	Number of account plants piece	Degree of defeat with a verticillium wilt							
		Healthy plants I (0)		Slightly affected II		Medium affected III		Severely affected IV	
		piece	%	piece	%	piece	%	piece	%
KS-1	7884	529	6,71	1039	13,18	2014	25,54	4302	54,57
AN-14	6761	217	3,21	1015	15,01	1972	29,17	3557	52,61
IL-296	7651	7188	93,95	221	2,89	242	3,16	-	-
IL-1378	7637	7079	92,69	275	3,60	283	3,71	-	-
IL-32	8147	7549	92,69	289	3,55	309	3,79	-	-
IL-296 x KS-1	14237	12368	86,87	1271	8,93	417	2,93	181	1,27
KS-1 x IL-296	14061	12479	88,75	1065	7,57	298	2,12	219	1,56
IL-296 x AN-14	13257	11684	88,13	1083	8,17	349	2,63	141	1,07
AN-14 x IL-296	12793	11368	88,86	1093	8,54	194	1,51	139	1,09
IL-1378 x KS-1	15129	13199	87,24	1279	8,46	478	3,16	173	1,14
KS-1 x IL-1378	14548	12977	89,20	1136	7,81	292	2,01	143	0,98
IL-1378 x AN-14	13187	11662	88,44	1097	8,32	259	1,96	169	1,28
AN-14 x IL-1378	14211	12578	88,51	1129	7,95	316	2,22	188	1,32
IL-32 x KS-1	13949	12569	90,11	1070	7,67	186	1,33	124	0,89
KS-1 x IL-32	14193	12567	88,54	1182	8,33	268	1,89	176	1,24
IL-32 x AN-14	13266	11884	89,58	1078	8,13	174	1,31	130	0,98
AN-14 x IL-32	14183	12569	88,62	1196	8,43	267	1,88	151	1,07

Also resistant to verticillium wilt introgressive parenting forms IL-296, IL-1378, IL-32 of the total surveyed plants in a weak degree was amazed 2.89, 3.60, and 3.55%. In medium degree was amazed 3.16, 3.71, and 3.79 %. It was not found plants with large extent affection.

In 12 reciprocal hybrids combination of the third generation in a weak degree affected by wilt plants ranged from 7,57 to 8,93 %, plants with middle affection by wilt ranged from 1.37 % to 2.93 %. And quantity of plants with a large extent affection by wilt ranged from 0.89 to 1.56 % (table 3).

4. Discussion and Conclusion

Enrichment and improvement of the gene pool of cultivated types of cotton through widespread use potential of wild species, developing and wide adoption in agricultural production new varieties of cotton is very important and promising direction. In this regard, wild, semi-wild species of cotton are the richest carrier of valuable traits, including high resistance to diseases and pests.

The wild diploid species of *G. trilobum* Srowstes cotton used in interspecies hybridization has a number of valuable traits.

The presence of recessive alleles of wilt-resistant genes in the genotype of allotetraploid parental varieties KS-1, AN-14 is shown. The introgressive initial lines IL-296, IL-1378, IL-32, obtained with the participation of the wild diploid

species of *G. trilobum* Skovcted cotton, have dominant genes of wilt-resistance.

In the generation of reciprocal plants F1 cotton is inherited a sign of high wilt-resistance of introgressive parental forms. By the indicator of resistance, a certain maternal effect is observed. In subsequent generations of F1, F2 in reciprocal hybrids, the proportion of wilt-resistance recombinants increases slightly, compared to the reciprocal plants F1, which indicates an increase in the expression of the resistance test.

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