

INHERITANCE OF DEVELOPMENTAL PHASES OF VEGETATION PERIOD DURATION IN INTRASPECIFIC HYBRIDS OF HOPCHATNIK DEPENDING ON THE TYPE OF FRUIT BRANCHES

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Abstract. *The article presents the results of inheritance of duration of development phases depending on the type of fruit branches. It was found that the studied developmental phases in intraspecific and interspecific F₁ hybrids by duration of vegetation periods "sowing-flowering", "flowering-ripening" and "sowing-ripening" have different genetic nature of inheritance, i.e. intermediate inheritance, dominance and overdominance in the direction of soon-ripening and late-ripening parent. In F₂ hybrids with marginal and non-marginal branching type, the inheritance of developmental phases is similar to F₁ hybrids, although in most cases, late maturity is inherited by dominance and overdominance. The type of fruiting branches is not significant in the inheritance of developmental phases. It should be noted that the studied developmental phases are complex polymeric traits, and their inheritance depends on the combinatory ability of parental forms.*

Keywords: *variety, line, hybrid combination, early maturity, cotton, flowering, ripening, plant, inheritance.*

Variety precocity is one of the main problems in cotton breeding. The first trait to which the breeder pays attention is early maturity. A variety that has high indices of economically valuable traits and resistance to diseases and pests, but does not have sufficient early maturity, cannot be recommended for production.

Rearing rate is a genetically determined property and largely depends on the development phases, duration of the growing season, bush shape and branching type. The relationship of cotton earliness with branching type has been studied by many researchers (Maksimenco, 1961; Dadabaev, Simongulyan, 1966, 1967; Sagdullaev 1968; Abrarov A.A. et al. 1976; Uzakov, Kholiyigitov (1976), Brezhnev D.D. et al. 1974; Amanturdiyev A.B. and Kim R.G. 2008).

Analysis of literature data shows that there are different opinions about the inheritance of the duration of the growing season of cotton. This is natural, because experimenters deal with different source material, the early maturity of which is genetically controlled ambiguously. In addition, the trait is subject to strong paratypic variability. Therefore, the study of this issue is relevant.

Material and methodology

In order to study the inheritance of this trait, we selected parental forms of cotton *G.hirsutum* L., sharply differing in early maturity, type of fruit branches and plant height: high-growing and medium-maturing variety Bukhara-10 with an indeterminate type of fruit branches, early maturing, medium-growing lines L-888, L-717, L-526, L-2014, L-2017, L-2021, L-2027 and L-1435 with an extreme type of fruit branches, as well as varieties S-8296 and S-8297 obtained by geographically distant hybridization with the participation of a collection sample of the US variety population L-02, as well as ruderal forms of ssp. punctatum (05152) and ssp. mexicanum (06422).

Results of the research

As a result of our research, we found that parental varieties and lines of cotton differ from each other in the duration of vegetation periods "sowing-flowering", "flowering-maturing", as well as in the number of days from sowing to maturity of the first boll and in the rate of opening. (Table 1).

The shortest vegetation period from sowing to flowering was obtained in variety S-8297, in lines L-888, L-717, L-2017, L-2021 with the limiting type of fruit branches of *G.hirsutum* L. A longer period from sowing to flowering was observed in high-growing varieties Bukhara-10 with the limiting type of fruit branches and S-8296 with the limiting type of fruit branches.

It should be noted that the duration of the vegetation period "flowering-ripening" in the studied varieties and lines is close and varies from 51.1 to 55.9 days, except for the variety Bukhara-10 and line L-2017 in which the period from flowering to ripening is from 56.5 to 58.5. L-1435 and L-2027 lines have the shortest flowering-maturity period, but their sowing-flowering period is longer.

The fastest maturing among the studied varieties and lines was variety S-8296, which had a vegetation period of 112.8 days and line L-2027, which had a vegetation period of 112.4 days. Relatively late maturing varieties were Bukhara-10, L-888, L-717, L-2017 and L-2021, in which the number of days from sowing to maturity of the first boll was 115.0 to 116.8 days.

The results of the analysis of phase inheritance on the duration of the growing season in intraspecific F₁ hybrids show that the period "sowing-flowering" in interspecific F₁ hybrids, with the participation of the maternal form of the line L-717 with the limiting type of fruit branches, in combinations L-717 x Bukhara-10 the average index is equal to 58.3 days, which is the result of negative (the trait of negative scorpeness is considered as positive) dominance ($hp=-2.7$) towards L-717 line, while in combination L-526 x Bukhara-10 intermediate inheritance ($hp=0.7$) was observed, and in combination L-2014 x S-8296 negative heterosis ($hp=-4.0$), i.e. overdominance of later maturing parent S-8296.

Negative dominance of this period inheritance and negative effect of heterosis was observed in cross combinations, where medium-growing early maturing varieties S-8296 and S-8297 with marginal type of fruit branches participated as a maternal form. Thus, in combinations L-2021 x S-8296, L-1435 x S-8296 and L-2027 x S-8297 the degree of dominance (hp) was -4.7, -3.9 and -3.4, respectively. In these hybrid combinations, the average indices for the "sowing-flowering" period were less than those of the parental forms by 1-2 days.

In most cases negative dominance of the trait was observed for the periods "flowering-maturity" and "sowing-maturity", especially in combinations with participation of varieties S-8296 and S-8297, i.e. negative dominance and overdominance (hp from -2.1 to -10.8) of paternal forms were observed. Only in three combinations L-526 x Bukhara-10, L-2014 x S-8296 and L-2027 x S-8297 negative intermediate inheritance was obtained for the flowering-maturity period

($h_p = -0.1$; -0.3 , respectively). Longer period of "flowering-ripening" by 3-5 days is observed in combinations L-888 x Bukhara-10, L-717 x Bukhara-10 and L-526 x Bukhara-10 where Bukhara-6 variety participates in the role of paternal forms than in hybrid combinations with participation of S-8296 and S-8297 variety, which led to increase of vegetation period in general up to 115.0-115.7 days.

Intermediate inheritance and dominance towards maternal forms ($h_p = 0.3$ to -1.4) was obtained in these combinations. In the combination L-2017 x S-8296, L-2021 x S-8296, L-1435 x S-8297 and L-2027 x S-8297 flowering-maturity period, negative overdominance of the trait was observed, where h_p is equal to -4.1 and -6.2 , respectively. In hybrid combinations, where the paternal form is variety Bukhara-10, the period of "sowing-ripening" is inherited in two cases as intermediate ($h_p = -0.2$ and -0.3), and in one case by the type of dominance towards maternal forms. In hybrid combinations involving the paternal variety S-8296, overdominance ($h_p = -7.6$ and 10.8) is observed in three cases and in spirit combinations involving variety S-8297 in one combination dominance of maternal form and in the other paternal form.

Table-1

Inheritance of growing season duration in intraspecific F₂ cotton hybrids.

№	Variety, line and hybrid combination	Sowing-flowering period			Flowering-ripening period			Sowing-ripening period		
		X+Sx	S	h_p	X+Sx	S	h_p	X+Sx	S	h_p
1.	S-8296	61.0 ± 0.5	4.4		55.8 ± 1.4	2.5		112.8 ± 0.7	6.2	
2.	S-8297	60.0 ± 0.5	4.0		55.8 ± 0.9	1.5		115.8 ± 0.7	6.5	
3.	Bukhara-10	62.5 ± 2.2	3.8		58.5 ± 1.7	3.0		121.0 ± 0.6	6.4	
4.	L-888	60.0 ± 0.5	4.1		55.4 ± 0.8	1.4		115.4 ± 0.7	6.0	
5.	L-717	60.2 ± 0.5	4.1		55.5 ± 2.0	3.5		115.7 ± 0.8	6.4	
6.	L-526	59.3 ± 0.6	3.8		55.6 ± 1.9	3.4		114.9 ± 1.1	6.8	
7.	L-2014	59.3 ± 0.6	3.8		55.9 ± 1.6	1.9		115.2 ± 0.9	5.5	
8.	L-2017	60.3 ± 0.5	3.4		56.5 ± 3.5	6.0		116.8 ± 0.8	5.2	
9.	L-2021	60.2 ± 0.7	4.6		55.2 ± 2.9	5.0		115.4 ± 1.3	8.2	
10.	L-1435	63.4 ± 0.6	3.8		51.6 ± 2.3	4.0		115.0 ± 0.8	5.5	
11.	L-2027	61.7 ± 0.6	2.5		51.1 ± 3.4	5.9		112.4 ± 0.6	2.7	
12.	L-888 x Bukhara-10	60.8 ± 0.7	3.9	0,3	54.1 ± 1.4	2.4	0,3	115.0 ± 0.8	5.5	-0,2
13.	L-717 x Bukhara-10	58.3 ± 0.5	2.5	-2,7	55.0 ± 3.9	6.8	-1,4	115.2 ± 0.7	4.2	-1,6
14.	L-526 x Bukhara-10	59.7 ± 0.8	4.1	0,7	56.1 ± 3.5	6.0	0,3	115.7 ± 1.2	6.4	-0,3
15.	L-2014 x S-8296	63.3 ± 0.6	3.4	-4,0	54.0 ± 3.5	6.0	0,1	113.4 ± 0.8	4.8	-7,6
16.	L-2017 x S-8296	60.2 ± 0.4	2.6	-1,3	52.5 ± 3.5	6.0	-6,0	110.8 ± 0.8	4.1	-10,8
17.	L-2021 x S-8296	59.6 ± 0.9	4.7	0,2	52.2 ± 2.3	4.0	-6,2	111.9 ± 0.7	3.5	-9,0
18.	L-1435 x S-8297	59.7 ± 0.7	3.9	-1,1	51.7 ± 1.1	2.7	-4,1	113.7 ± 0.7	3.9	-2,1
19.	L-2027 x S-8297	59.6 ± 0.7	3.4	-1,5	52.6 ± 2.8	4.8	-5,8	113.7 ± 0.7	3.6	-2,1

Consequently, based on the obtained data, it can be noted that the studied developmental phases in intraspecific F₁ hybrids in terms of duration of vegetation periods "sowing-flowering", "flowering-maturing" and "sowing-maturing" have different genetic nature of inheritance, i.e. intermediate inheritance, dominance and over-dominance towards early-ripening and late-ripening parent. It should be noted that the studied periods are complex polymeric traits, and their inheritance depends on the combinatory ability of parental forms.

It should be noted that inheritance of developmental phases by duration of vegetation periods in F₂ hybrids was studied depending on the type of fruit branches, i.e. hybrids with marginal and non-marginal type of branching.

Analysis of the results obtained for the development phase "sowing-flowering" in intraspecific hybrids with limit type of fruit branches revealed that the shortest period of "sowing-flowering" has hybrids L-526 x Bukhara-10 and L-2014 x S-8296, which have an average of 60.2 and 60.4 days, respectively. The duration of this period in hybrid combinations L-717 x Bukhara-

10, L-2017 x S-8296 and L-2021 x S-8296 was the longest. The average index in these hybrids is 63.1 and 63.5 days, respectively. In the other hybrid combinations, the average of this period varied from 62.3 to 62.6 days. (Table 2).

Duration of vegetation period "flowering-maturity" in hybrid combinations L-2017 x S-8296, L-2021 x S-8296 and L-1435 x S-8297 was equal to 50.5 and 53.7 days, respectively, and in other studied combinations this indicator was much longer and averaged from 56.1 to 60.9 days. (Table 2).

Table 2 shows that variability of variation series of "sowing-ripening" period in intraspecific hybrids F₂ with the limiting type of fruit branches is mainly located within the parental forms, except for hybrid combination L-717 x Bukhara-10, where there is a weak right-hand transgression with selection of plants with longer period and combination L-2014 x S-8296 where right-handed transgression with leaching of plants with a longer "sowing-maturity" period was observed.

A somewhat different picture is observed in combinations with participation of the paternal variety S-8296 with a limiting type of branching. So, for example, in all combinations there is a wide form-forming process with leaching of plants exceeding the limits of parental forms by 1-2 classes. As a result, hybrid plants with duration of the vegetation period "sowing-maturing" up to 114-115 days are leached. The average indices of the studied hybrid combinations ranged from 114 to 120 days.

Table-2

Inheritance of growing season length in intraspecific and interspecific F₂ hybrids.

Variety, line and hybrid combination	Периоды									X+Sx	V%
	Sowing-flowering	Flowering-ripening	Sowing-ripening								
			Boundary of classes, days, K=5								
X+Sx	X+Sx	105-109	110-114	115-119	120-124	125-129	130-134	135-139			
Hybrids with unsaturated type of fruit branches											
S-8296	60.0 ± 0.3	51.6 ± 1.5	11	56	5		-	-	-	111.6 ± 0.5	3.4
S-8297	65.0 ± 0.7	49.4 ± 0.6	8	12	4	6	4	-	-	114.4 ± 1.3	5.7
Bukhara-10	63.3 ± 0.5	57.2 ± 1.5	3	5	5	13	8	-	-	120.5 ± 1.1	4.5
L-888	62.2 ± 0.3	55.9 ± 1.1	-	13	54	22	-	-	-	117.1 ± 0.6	4.2
L-717	59.2 ± 0.3	57.5 ± 1.2	-	10	14	51	1	-	-	115.7 ± 0.6	3.8
L-526	62.4 ± 0.6	53.4 ± 2.0	8	8	23	12	-	-	-	115.8 ± 0.7	3.7
L-2014	61.2 ± 0.3	57.7 ± 1.7	10	44	22	2	-	-	-	115.9 ± 0.7	4.2
L-2017	64.0 ± 0.3	55.5 ± 1.8	-	2	31	19	7			116.5 ± 0.5	2.9
L-2021	62.1 ± 0.3	52.2 ± 1.3	1	50	20	7	-	-	-	114.3 ± 0.5	3.6
L-1435	65.0 ± 0.4	50.3 ± 0.5	-	18	12	12	-	-	-	115.3 ± 0.8	3.8
L-2027	62.6 ± 0.6	55.6 ± 1.2	6	16	5	4	-	-	-	113.0 ± 0.8	3.2
L-888 Bukhara-10	62.3 ± 0.3	56.8 ± 1.1	3	5	16	12	4	-	-	119.1 ± 0.8	3.7
L-717 x Bukhara-10	63.5 ± 0.5	60.5 ± 0.8	-	4	2	22	9	13	-	120.2 ± 0.9	4.5
L-526 x Bukhara-10	60.2 ± 0.5	59.4 ± 1.1	3	6	5	26	4	-	-	119.6 ± 0.8	3.8
L-2014 x S-8296	60.4 ± 0.7	56.1 ± 1.2	7	21	6	8	6	4	-	116.5 ± 1.1	5.8
L-2017 x S-8296	64.7 ± 0.5	50.5 ± 0.8	9	20	14	11	4	-	-	115.2 ± 0.8	4.5
L-2021 x S-8296	63.1 ± 0.6	53.1 ± 1.3	4	23	10	12	3	2	-	116.2 ± 0.8	4.5
L-1435 x S-8297	62.3 ± 0.5	53.7 ± 0.8	7	5	32	5	3	-	-	116.0 ± 0.8	4.1
L-2027 x S-8297	62.6 ± 0.6	60.9 ± 1.8	3	7	15	4	3	-	-	114.5 ± 0.9	3.6

In the majority of hybrid combinations, for example L-2017 x S-8296 and L-2027 x S-8297, left-handed transgression was detected, which resulted in plants in 114-115-day classes. In the remaining two combinations L-888 x Bukhara-10 and L-717 x Bukhara-10, plants outside the classes of parental forms were found, but to the right side of the variation series. Due to this, the average indices of this period in hybrid combinations became longer (120.2, 119.1, respectively).

Table 3 shows the results obtained for the studied periods of developmental phases in F₂ intraspecific hybrids with the nonspecific type of fruit branches. The table shows that the studied

interspecific and intraspecific hybrids with the nonspecific type of fruit branches by duration of the vegetation period "sowing-flowering" mainly had average indicators within 59.5-63.0 days. It should be noted that in hybrid combinations L-888 x Bukhara-10, L-526 x Bukhara-10 and L-2014 x S-8296 the period of "sowing-flowering" was the shortest. They were equal to 59.5- 60.1 and 60.9 days, respectively.

It should be noted that the duration of the vegetation period "flowering-maturation" in intraspecific hybrids mainly have a shorter period than "sowing-flowering". For example, hybrids L-888 x Buhora-10, L-2014 x S-8296, L-2017 x S-8296 and L-1435 x S-8297 had average values from 53.5 to 58.5 days.

Table-3

Inheritance of growing season length in intraspecific and interspecific F₂ hybrids.

Variety, line and hybrid combination	Периоды									X+Sx	V%
	Sowing-flowering	Flowering-ripening	Sowing-ripening								
	X+Sx	X+Sx	Boundary of classes, days, K=5								
		105-109	110-114	115-119	120-124	125-129	130-134	135-139			
Hybrids with unsaturated type of fruit branches											
S-8296	60.0 ± 0.3	52.6 ± 1.5	11	56	5	-	-	-	-	112.6 ± 0.5	3.4
S-8297	61.6 ± 0.6	56.4 ± 0.8	1	6	21	5	-	-	-	115.1 ± 0.7	2.9
Bukhara-10	65.2 ± 0.3	58.9 ± 1.1	-	-	13	54	22	-	-	124.1 ± 0.6	4.2
L-888	63.5 ± 0.5	55.7 ± 1.2	4	6	11	14	10	-	-	119.2 ± 0.9	4.4
L-717	59.2 ± 0.3	56.5 ± 1.2	10	17	48	1	-	-	-	115.7 ± 0.6	3.8
L-526	63.7 ± 0.6	52.9 ± 0.5	9	9	22	14	4	-	-	116.6 ± 0.8	4.4
L-2014	61.2 ± 0.3	57.7 ± 1.7	-	12	42	22	2	-	-	118.9 ± 0.7	4.2
L-2017	64.0 ± 0.3	55.5 ± 1.8	-	4	29	19	7	-	-	119.5 ± 0.5	2.9
L-2021	62.1 ± 0.3	52.2 ± 1.3	1	50	20	7	-	-	-	114.3 ± 0.5	3.6
L-1435	62.2 ± 0.4	51.3 ± 0.5	18	12	12	-	-	-	-	113.5 ± 0.8	3.8
L-2027	63.2 ± 0.5	56.1 ± 0.6	2	5	29	13	4	5	-	119.3 ± 0.8	4.1
L-888 x Bukhara-10	59.5 ± 0.6	58.5 ± 0.9	3	21	9	5	3	-	-	118.0 ± 0.8	3.9
L-717 x Bukhara-10	62.0 ± 0.6	61.1 ± 0.8	2	3	4	21	15	2	-	123.5 ± 0.8	4.2
L-526 x Bukhara-10	60.1 ± 0.4	62.9 ± 1.2	3	3	8	32	16	10	-	123.0 ± 0.8	4.7
L-2014 x S-8296	60.9 ± 0.5	55.6 ± 0.6	3	17	21	15	5	-	-	116.5 ± 0.7	3.8
L-2017 x S-8296	61.5 ± 0.5	53.5 ± 0.9	2	3	5	17	5	-	-	115.0 ± 0.9	3.7
L-2021 x S-8296	61.3 ± 0.5	56.9 ± 0.7	3	6	5	27	4	-	-	118.2 ± 0.8	3.5
L-1435 x S-8297	62.2 ± 0.2	54.0 ± 0.6	5	11	15	14	6	-	-	116.2 ± 1.0	5.1
L-2027 x S-8297	63.0 ± 0.6	58.8 ± 1.0	-	5	4	23	6	5	-	121.8 ± 0.8	3.8

It should be noted that inheritance of duration of vegetation periods "sowing-flowering", "flowering-ripening" and "sowing-ripening" in the studied intraspecific hybrids F₂ with marginal and non-marginal branching type is similar to F₁ hybrids, i.e. intermediate inheritance, dominance and overdominance towards soon-ripening and late-ripening parent is observed. The type of fruit branches is not significant in the inheritance of the studied traits. Although in most cases, late ripeness is inherited according to the principle of dominance and overdominance.

Analyses of variation series of hybrid plants with non-limiting type of fruit branches by the period "sowing-maturity", showed almost identical picture, which is observed with plants of the limiting type. (Table 3).

Conclusions

1. The studied developmental phases in F₁ intraspecific hybrids in terms of duration of vegetation periods "sowing-flowering", "flowering-ripening" and "sowing-ripening" have different genetic nature of inheritance, i.e. intermediate inheritance, dominance and overdominance towards the early-ripening and late-ripening parent.

2. Inheritance of duration of growing seasons "sowing-flowering", "flowering-maturing" and "sowing-maturing" in the studied intraspecific F₂ hybrids with marginal and non-marginal

branching type is similar to F₁ hybrids, i.e. intermediate inheritance, dominance and overdominance towards early-ripening and late-ripening parent is observed. Though in most of the cases late maturity is inherited by dominance and over dominance.

3. The developmental periods under study are complex polymeric traits and their inheritance depends on the combinatorial ability of the parental forms.

4. The type of fruit branches is not significant in the inheritance of developmental phases. In the studied combinations, a wide form-forming process is observed regardless of the type of branching.

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