APPLIED THE THEORY OF RELATIVE HERITABILITY TO CALCULATE THE HETEROSIS OF SUNFLOWER

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SUMMARY

Theory of heritability was based on the principle of parents selection to analyse the quantitative relationship between parents and filial generation by means of character value and the relative heritability value. On hybridization bbeeding, generally speaking, the cha rcter value of a hybrid can be indicated with arithmetic means of parents' genetic character value. However, because the heritability of parents' genetic character is not on an equal basis frequently, some heritatary feature of some parents have a high heritability so that the filial generations are influenced significantly by parents. It was not suitable for heritability to adopt simple arithmetic mean, therefore, the weighted mean should be adopted to be suitable for objective reality.

INTRODUCTION

The theory of relative heritability was advanced by Prof.Pei Xinkai who was a genetist in Hunan Agriculture College in China. The theory was utilized to calculate genetic trends of parents' genetic characters, forecast heterosis and direct breeding works in rice A-line, B-line and R-line breeding. The theory have turned in a good effect in breeding process. In this paper, the theory was utilized on sunflower heterosis breeding, and also obtained primary results in 1981-1982. The theoretical basis was established for selecting high heterosis cross combinations in sunflower.

MATERIALS AND METHODS

The relative heritability was dealt with that seven characters of fourteen cross combinations were involved in this trial in 1981 - 1982 (Table 1). As is known to all, in some agronomy characters, almost parents all can display conditionality to filial generation. Under relatively consistent environment conditions, the phenotypes of filial generations have a close relation with anyone of parents. However, since parents' heritability was different, so that filial generation was influenced by parents were very different, too. The heritability is an ability that parents transmit their characteristics and features to filial generations. The ability is different in different varieties and characteristics. Character representation of a hybrid also depend on relative intensity of heritability between parents, so it is called "Relative heritability". Every parent's character with high relative heritability can be easily developed to dominant character in filial generation. Therefore, the genetic character of parents (p1, p2) and relative heritability (a1, a2) are decisive factors for character representation in filial generation. The simplely quantitative relation formula is : $F1 = a1p1+a2p2$, in it: a1 and a2 stand for the relative heritability of higher parent's character value and lower parent's character value, respectively; p1 and p2 stand for character mean of higher parent's mean and lower parent's mean, separately; F1——

character mean of F1 generation. This formula is able to sum up all kinds of dominances of hybrid. F1 generation will appear heterosis when have been significant difference and a1 and a2 have had complementary relationship. The signs of a1 and a2 are opposite (positive sign and minus sign), a1 and a2 are comple - mentary relationship; as a1 and a2 have the same sign (all of positive sign or all of minus sign), a1 and a2 have refused relationship each other. However, the sum of a1 and a2, wether complementary relationship or refused relationship are equal to 1 (mean a1 + a2 = 1). On the basis of above-mentioned relation, a1 and a2 are achieved:

$a1 = \frac{F1-p2}{p1-p2}$; $a2 = \frac{p1 - F1}{p1 - p2}$. As a1 > 0.5 (or one second)

mean a1 > a2, a2 > 0 mean positively partal dominance in character; as a1 < 0.5 (or one second), a2 > o.5 (or one second) mean a2 > a1 mean negatively partal dominance in character. As a1 < 0 means negatively epistatic dominance; a1 > 1 means positively epistatic dominance in character; a1=1 means positively complete dominance; a1 = 0.5 (or one second) means non-dominance.

According to above-mentioned theory, the major agronomic characters in fourteen cross combinations were dealt with genetic analyse.

RESULTS AND DISCUSIONS

The relative heritability(a1) of seven characters were determined in 1982 (Table 1). The results shown that the number of cross combinations of which a1 and a2 value were opposited (complementary) made up proportion on every character as follows: A. Plant hight: 100%; B. Seed oil percentage: 92.8%; C. The number of outcome seed: 85.7%; D. Weight of per head: 78.5%; E. Kernel percentage: 64.2%; F. Diameter of head: 50%; G. Weight of per 100 seed: 28.5%.

1. Genetics and calculation of plant hight in hybrids:
Although plant hight of hybrids were conditioned by parents, most of them tended to male parent. The result shown that plant hight was greatly influenced by male parent. If male parent was higher plant hight, the F1 generation would be higher relatively. (Table 2).

According to table2 analysi of relative heriyability, when a1 is not equal to a2, the formula which is $F1=\overline{p} +(a1-0.5)(p1-p2)$ can be adopted to caclculate plant hight of F1 generation. e.g : "74102A × SH75-2-1", because of a1 ≠ a2, so F1 = 127.9 +(1.428 - 0.5)(141.1 - 114.7)= 152.3 cm. The theoretical value of plant hight tallies with actual value of average of F1 generation ($\overline{F}1$ = 152.4 cm).

2. Genetics and calculation of weight of per 100 seed in hybrids:
The results(table 3) shown:
A. The wight of per 100 seed in most of F1 generations approach to the arithmetic mean of two parents' weight of per 100 seed nearly. The result testified that weight of per 100 seed of F1

Table 1. The relative heritability of seven characters in fourteen cross combinations:

Relative heritability (a1) / Cross combination		Character: Plant hight (cm)	Head size (cm)	Outcome seed	Seed weight of per head (g)	Weight of per 100 seeds (g)	Percentage of kernel (%)	Percentage of seedoil (%)
74102A ×	SH75-2-1	1.428	0.900	3.682	26.400	0.676	1.290	2.000
	No27-3-1-4-1	2.797	1.363	7.181	2.631	0.578	1.065	1.807
	7813-2-2-3-2	1.645	1.571	3.183	1.750	0.538	1.388	1.557
	So64-4-1-2	1.841	3.474	6.395	3.512	0.822	1.102	1.222
	7501-2-1-5-3-1-4	3.836	3.444	16.560	3.600	1.057	0.582	0.927
76202A ×	So57-4-3-1-1-1	3.041	0.200	0.973	0.701	0.544	0.837	2.309
	7838-3-2-1	3.745	0.607	1.738	1.086	0.176	0.851	1.377
	7848-1-5-3	7.622	-0.275	0.499	0.809	1.118	0.631	1.210
	7874-2-4-1	1.519	0.730	2.022	0.906	0.493	0.878	1.309
75144A ×	So57-4-3-1-1-1	3.915	1.174	2.321	4,155	0.518	1.447	7.200
	SH75-3-6	1.066	2.438	3.264	4.163	0.377	1.368	1.900
	(cpk32 Tr41)-1-4-2	2.919	0.538	1.006	3.621	0.490	2.957	4.000
75151A ×	7880-3-1-5	1.969	2.364	1.462	1.289	1.632	1.102	7.800
	SH75-3-6	1.300	0.688	42.400	5.122	1.286	1.761	5.500

Table 2. The genetics oh plant hight in F1 generation:

Cross combination		Plant hight (cm)						a1	SItuation (F1)
		p1	p2	$\bar{p}$	F1	p1-p2	F1-$\bar{p}$		
74102A ×	SH75-2-1	141.1(♀)	114.7(♂)	127.9	152.4	26.4	24.5	1.428	Over(♀), (+)epistatic dominance.
	No27-3-1-4-1	141.1(♀)	126.8(♂)	133.9	166.8	14.3	32.9	2.797	"
	7813-2-2-3-2	141.1(♀)	99.6(♂)	120.3	160.4	41.5	40.1	1.465	"
	So64-4-1-2	141.1(♀)	103.9(♂)	122.5	172.4	37.2	49.9	1.841	"
	7501-2-1-5-3-1-4	141.1(♀)	129.5(♂)	135.3	174.0	11.6	38.7	3.836	"

74102A X	So57-4-3-1-1-1	150.1(♀)	135.4(♂)	142.7	180.1	14.7	37.4	3.041	Over ♀,(+) epistatic dominance
	7838-3-2-1	150.1(♀)	139.5(♂)	144.8	179.2	10.6	34.4	3.745	"
	7848-1-5-3	153.8(♂)	150.1(♀)	151.9	178.3	3.7	26.4	7.622	Over ♂, "
	7874-2-4-1	150.1(♀)	124.1(♂)	137.1	163.6	26.5	26.5	1.519	Over ♀, "
76202A X	So57-4-3-1-1-1	135.4(♂)	130.7(♀)	133.0	149.1	4.7	16.1	3.915	Over ♂, "
	SH75-3-6	130.7(♀)	88.7(♂)	109.6	133.5	42.2	23.9	1.066	Over ♀, "
	(cpk32 Tr41)-1-4-2	143.0(♂)	130.7(♀)	136.8	166.6	12.3	29.8	2.919	Over ♂, "
75151A X	7880-3-1-5	140.5(♂)	121.1(♀)	130.8	159.3	19.4	28.5	1.969	"
	SH75-3-6	121.1(♀)	88.5(♂)	104.8	130.9	32.6	26.1	1.300	Over ♀, "

Table 3. Genetics on weight of per 100 seeds in F1 generation:

Cross combination		Weight of per 100 seeds (g)						a1	Situation (F1)
		p1	p2	$\overline{p}$	F1	p1-p2	F1-$\overline{p}$		
74102A X	SH75-2-1	8.2(♀)	4.8(♂)	6.5	7.1	3.4	0.6	0.676	Tend ♀, (+) partial dominance.
	No27-3-1-4-1	8.2(♀)	2.5(♂)	5.4	5.8	5.7	0.4	0.578	Middle, " .
	7813-2-2-3-2	8.2(♀)	3.0(♂)	5.6	5.8	5.2	0.2	0.538	" " .
	So64-4-1-2	8.2(♀)	3.7(♂)	6.0	7.4	4.5	1.4	0.822	Tend ♀, " .
	7501-2-1-5-3-1-4	8.2(♀)	4.7(♂)	6.5	8.4	3.5	1.9	1.057	Over ♀, (+) epistatic dominance.
76202A X	So57-4-3-1-1-1	10.1(♀)	3.4(♂)	6.8	7.0	6.7	0.2	0.544	Middle, (+) partial dominance.
	7838-3-2-1	10.1(♀)	4.1(♂)	7.1	8.4	6.0	1.3	0.716	" " .
	7848-1-5-3	10.1(♀)	8.4(♂)	9.3	10.3	1.7	1.0	1.118	Over ♀, (+) epiatatic dominance.
	7874-2-4-1	10.1(♀)	3.4(♂)	6.8	6.7	6.7	-0.1	0.493	Tend ♂, (-) partial dominance.
75144A X	So57-4-3-1-1-1	8.9(♀)	3.3(♂)	6.1	6.2	5.6	0.1	0.518	Middle, (+) " .
	SH75-3-6	8.9(♀)	3.6(♂)	6.3	5.6	5.3	-0.7	0.377	Tend ♂, (-) " .
	(cpk32 Tr41)-1-4-2	8.9(♀)	4.0(♂)	6.5	6.4	4.9	-0.1	0.490	" " .
75151A X	7880-3-1-5	7.9(♂)	5.7(♀)	6.8	8.8	2.2	2.0	1.632	Over ♂, (+) epistatic dominance.
	SH75-3-6	5.7(♀)	3.6(♂)	4.7	6.3	2.3	1.6	1.286	Over ♀, " .

was conditioned strictly by two parents. B. The heritability of weight of per 100 seeds was different among parents by means of analysing different cross combinations, so the character representation was different in F1 generation too. Majority of F1 generations tended to male parent in fourteen cross combinations. The reslut shown that the character of weight of per100 seeds was greatly influenced by male parent in F1 generation. C. All of two parents with relatively heavey weight ofper 100 seeds crossed, the heavey weight of per 100 seeds would be obtained in F1 generation. If there are greatly different between two parents, the character of weight of per 100 seeds will approach to intermediate type in F1 generation.

Two formulae can be utilized to calculate the weight of per 100 seeds of F1 generation. A. When the relative heritabilies of two parents are equal in number($a1=a2=0.5$) and the character is non-dominance(or partial dominance), the formula $F1=0.5(p1-p2)$ can be adopted to calculate weight of per 100 seeds of F1. B. As the relative heritability of two are different($a1 > a2 > 0$, or $a1 < a2$, $a1 > 0$), the formula $F1=\bar{p}+(a1-0.5)(p1-p2)$ can be adopted to calculate the weight of per 100 seeds of F1.

CONCLUSIONS

The results of test cross experiment and breeding practice testified that the genetic character of parents and relative heritability of parents are hereditary basis which decided the character representation of filial generations under designed environment. But yet occuring the heterosis was due to the genetic difference between parents to be increased and intercompementary causes. By above-mentioned estimatics, the heterosis of plant hight, seedoil contents, outcome seed and seed weight of per head were greatly high. Therefore, in parents selection, the parents with bigger diameter of head, high percentage of kernel and relative high weight of per 100 seeds are possible to obtain high-yield cross combinations.

The relative heritability is based on the principle of parents selection, the quantitative relation between parents and filial generation can be analysed by means of parents' genetic character value and relative heritability. Therefore, not only the two characteristics of heterosis were really reported, but also accorded with the essence of heterosis completely.

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