Combining Ability of a Cucumber Drugs Abuse

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ABSTRACT

The general and specific combining ability of sex promising cucumber lines in the diallel cross-breeding system of the World Vegetable Center was selected. The following quantitative characteristics were considered: the number of days before the disclosure of the female flowers, the number of days before the technical ripeness of the fruit, the number of fruits on one plant, the average weight of the fruit, the productivity of one plant. When comparing the varieties of SCA and GCA in cucumber samples according to the main economically valuable characteristics, it was found:

-according to the signs “the number of days before the female flowers open” and “the number of days to the technical ripeness of the fruit”, the ratio σ2ĝi< σ2si is observed in all the studied cucumber samples, where genes with dominant and epistatic effects also prevail in inheriting this trait;

-the sign “the number of fruits per plant” is controlled by dominant and epistatic effects of genes ($\sigma^2_{\hat{g}i} < \sigma^2_{si}$) in almost all cucumber samples and in the sample “A-6” by additive gene effects ($\sigma^2_{\hat{g}i} > \sigma^2_{si}$);

-on the basis of “average fruit weight”, the phenomenon $\sigma^2_{\hat{g}i} < \sigma^2_{si}$ was noted, where the manifestation of the trait is controlled by the dominant and epistatic effects of genes ($\sigma^2_{\hat{g}i} < \sigma^2_{si}$) in the three studied cucumber samples («C-25/1 (Ifor)», «A-6» и «A-9») and in the other three samples, additive gene effects ($\sigma^2_{\hat{g}i} > \sigma^2_{si}$) are more important during inheritance;

-the sign “productivity of one plant” is controlled by dominant and epistatic effects of genes ($\sigma^2_{\hat{g}i} < \sigma^2_{si}$) in the three studied cucumber samples and in the three samples («C-25/1 (Ifor)», «A-6» и «A-9») for the manifestation of the trait, genes with additive effects play a special role.

Keywords: cucumber, general combining ability, specific combining ability, number of fruits on one plant, average weight of a fruit, number of days before female flowers open.

Introduction

The success of breeding primarily depends on the selection of the source material and its correct study. One of the main selection methods is the determination of the combining ability. The combinative ability of the parental forms is a defining feature in the creation of heterozygous hybrids. Breeding heterozygous

hybrids is essentially a selection of combinational ability [1-2].

It has been proven that varieties with high combinative ability give more productive hybrid offspring than varieties with low combinational ability. Due to the fact that the selection of varieties should be carried out mainly for high combinational ability, clarification of the genetic basis of this parameter, as well as further modernization of methods for its assessment, become one of the most important tasks of modern genetics [1-6].

Analysis of variance on effects of combining ability shows that there are significant differences in specific combining ability (SCA), and for some of them, also in general combining ability (GCA). One of the most important steps in the analysis is comparing the value of the samples. The GCA of one sample can be compared with the GCA of another sample directly by the quantitative results of its effects. In addition to comparing the variance of the SCA (σ^2si) of different samples, it is interesting to compare the relative values of the variance of the GCA and the SCA of the same sample, since the relative difference in the estimates of the variance of the GCA and the SCA can be explained in terms of genes and gene interaction. When the σ^2ĝi score is low, this indicates that this line is the average for the GCA among the studied group of samples. High σ^2ĝi can be when a given sample is much better or much worse than another sample with which it is being compared. Based on the variance of SCA, one can judge the importance of genes that are the result of their additive action. A high SCA variance indicates that some combinations involving a given sample are relatively worse than would be expected based on the average sample value. Samples with low σ^2si can only be evaluated by their GCA. The specific combining ability depends on genes with dominant and epistatic effects [1-2, 5].

Studies on the study of the combining ability of cucumber samples for the main economically valuable traits in the world have been carried out by many researchers, but especially the works of Russian [7, 10] and Indian scientists [8-9, 11-12] should be noted.

Materials and methods

Purpose of these studies was to evaluate cucumber samples according to the combining ability of the main economically valuable traits with their subsequent use in a breeding program to create highly productive and high-quality varieties and hybrids.

19 cucumber samples obtained from the World Vegetable Center (WorldVeg, Taiwan) were studied.

According to the results of the study, 6 samples of cucumber were distinguished by a complex of economically valuable traits: "S-25/1 (Ifor)", "S-25/2", "S-26", "S-29", "A-6" and "A-9", which were included in the crosses. As a result of diallelic crosses, 30 hybrid combinations were obtained (p^2). Hybridological analysis was carried out according to the first Griffing method [13], which included forward and backcrosses and used parental forms (p^2). To determine the combinational ability in the system of diallelic crosses, the generally accepted methods were used [1, 15]. Genetic-statistical analyzes were carried out using the MS Excel application package.

The following quantitative traits were considered: the number of days before the opening of the mother flowers, the number of days before the technical ripeness of the fruit, the number of fruits per plant, the average weight of the fruit, the productivity of one plant. Analysis of variance, carried out for all the studied characters, showed the significance of genotypic differences between hybrid combinations, which made it possible to analyze these differences in combining ability.

Results and discussion

The results of evaluating the combining ability of cucumber samples in the diallel crosses system showed differences.

Number of days before maternal flowers open. When analyzing the combining ability, it was found that the lowest GCA values, which determine the relative early maturity, had the samples "C-25/2" ($\hat{g}_i$ = -1.81) and “C-26” ($\hat{g}_i$ = -0.65), but their SCA variances differ. For example, sample "C-25/2" has the highest SCA

variance (σ^2_{si} = 1.30), and sample "C-26" (σ^2_{si} = -1.57) - relatively low. Samples "S-25/1 (Ifor)" and "A-9" have the lowest GCA variance values (σ^2_{gi} = -1.99 and σ^2_{gi} = -1.93), respectively. Sample "S-29" differs from the rest of the samples in its high GCA effect (ĝi = 1.48), its GCA variances (σ^2_{si} = 0.20) and SCA (σ^2_{si} = 0.20) have an average significance. This indicates an increase in the duration of the growing season before the maternal flowers of hybrid combinations open relative to the average values of the parental forms. The SCA variance values for this trait in samples A-9 (σ^2_{si} = 3.85) and C-26 (σ^2_{si} = 3.75) had high values, although their indicators of effects and variations in GCA were relatively low (ĝi = 0.25, σ^2_{gi} =-1.93 and ĝi = -0.65, σ^2_{gi} = -1.57), respectively (table 1).

In almost all of the studied cucumber samples, the variance of the SCA for the "number of days before the opening of the mother flowers" prevails over the values of the variance of the GCA ($\sigma^2_{ĝi} < \sigma^2_{si}$). This phenomenon indicates the predominant role of genes with dominant and epistatic effects in the inheritance of this trait.

Table 1

Assessment of the effects of GCA, variance of GCA and SCA in cucumber samples by economically valuable traits in the system of diallelic crosses

Original forms	Effects of GCA ($\hat{g}$), variance GCA (σ^2_{gi}) and SCA (σ^2_{si}) according to the signs														
	Number of days, before						Number of fruits per plant			Average mass of fruit, gr			Productivity of one plant, kg		
	Disclosure maternal flower			Technical ripeness of the fruit											
	g_i	σ^2_{gi}	σ^2_{si}	g_i	σ^2_{gi}	σ^2_{si}	g_i	σ^2_{gi}	σ^2_{si}	g_i	σ^2_{gi}	σ^2_{si}	g_i	σ^2_{gi}	σ^2_{si}
C-25/1 (Ifor)	0,02	-1,99	6,44	0,99	-0,83	4,48	-0,26	-0,14	0,18	-6,32	29,11	27,57	-60,3	1447,2	1443,6
C-25/2	-1,81	1,30	1,81	-1,40	0,15	1,23	-0,47	0,01	0,07	-4,58	10,16	66,68	-65,2	2072,6	2702,2
C-26	-0,65	-1,57	3,75	-1,78	1,34	3,14	0,18	-0,18	0,15	-5,05	14,65	132,08	-18,5	-1841,2	4863,2
C-29	1,48	0,20	0,94	1,26	-0,22	1,62	-0,15	-0,19	0,11	-0,46	-10,59	111,77	-16,7	-1906,3	4887,9
A-6	0,71	0,90	1,83	0,91	1,19	3,98	0,53	0,33	0,09	5,96	37,72	13,45	82,1	7176,9	1074,4
A-9	0,25	-1,93	3,85	0,01	-1,82	4,09	0,17	-0,18	0,14	10,44	98,20	70,67	78,6	3989,1	3579,5

Standard errors

Restrictions		Number of days		Number of fruits per plant	Average mass of fruit, gr	Productivity of one plant, kg
		Before disclosure maternal flower	Before the technical repining of the fruit			
$i = j$	$\hat{g}_i - \hat{g}_j$	0,60	0,56	0,09	0,85	8,46
$i = j, j = k$	$\hat{g}_{ij} - \hat{g}_{jk}$	1,35	1,26	0,21	1,89	18,92
$i=j,k;l;j=k,k=l$	$\hat{g}_{ij} - \hat{g}_{jl}$	1,21	1,12	0,19	1,69	16,92

Hybrid combinations with a short growing season before the maternal flowers open up were identified: C-25/1 (Ifor) x C-25/2, C-26 x C-25/2, C-26 x C25 / 1 (Ifor), A- 9 x C-26 and A-6 x C-25/1 (Ifor), in which the mother flowers open in 46-49 days.

The number of days until the technical ripeness of the fruit. Based on the analysis of the combining ability of the trait, it was found that the lowest rates of GCA effects were observed in samples «C-26» ($\hat{g}_i$ = -1,78) and «C-25/2» ($\hat{g}_i$ = -1,40), in which variance GCA (σ^2_{gi} = 1.34, σ^2_{gi} = 0.15) and SCA σ^2_{gi} = 3.14, σ^2_{gi} = 1.23) had average values, respectively. High GCA effects were observed in samples "S-25/1 (Ifor)" (i = 0.99) and "A-6" (ĝi = 0.91), the variances of GCA and SCA were different. For sample "S-25/1 (Ifor)", the variance of the GCA had a relatively low index ($\sigma^2_{ĝi}$ = -0.83), but the variance of the SCA had the highest significance (σ^2_{si} = 4.48). A

similar picture is observed for sample "A-9". Sample "S-26" had high and medium variance values for GCA ($\sigma^2_{\hat{g}i}$ = 1.34) and GCA (σ^2_{si} = 3.14), although it has the lowest indicator of the GCA effect (ĝi = -1.78).

In all the studied cucumber samples, the ratio $\sigma^2_{\hat{g}i} < \sigma^2_{si}$ is observed according to the trait "number of days before the technical ripeness of fruits", where the dominant role in the inheritance of this trait also belongs to genes with dominant and epistatic effects.

The best in terms of "the number of days before the technical ripeness of fruits" were the hybrid combinations: C-25/1 (Ifor) x C-25/2, A-9 x C-26, A-6 x A-9 and C-26 x C-25/1 (Ifor), the technical ripeness of the fruits of which came on 57-60 days.

The number of fruits per plant. The analysis of the combinational ability of the studied samples according to the characteristic "number of fruits per plant" shows that the highest significance of the GCA effect (ĝi = 0.53) was observed in the sample "A-6", and it also had a high and medium GCA variance ($\sigma^2_{\hat{g}i}$ = 0.33) and SCA (σ^2_{si} = 0.09). High values of SCA variance are observed in samples "S-25/1 (Ifor)" (σ^2_{si} = 0.18), "S-26" (σ^2_{si} = 0.15) and "A-9" (σ^2_{si} = 0.14), but the variances of the GCA had relatively high negative values ($\sigma^2_{\hat{g}i}$ = -0.14, $\sigma^2_{\hat{g}i}$ = -0.18 and $\sigma^2_{\hat{g}i}$ = -0.18, respectively). Although samples "C-26" ($\hat{g}_i$ = 0,18) and "A-9" ($\hat{g}_i$ = 0,17) had average positive GCA effects, but sample "C-25/1 (Ifor)" showed a negative the significance of the indicator (ĝi = -0.26).

In all studied cucumber samples, except for sample "A-6", the SCA variance exceeds the GCA variance ($\sigma^2_{\hat{g}i} < \sigma^2_{si}$), where the dominant and epistatic effects in inheriting the trait "number of fruits per plant" are much more important than additive effects. The opposite phenomenon is observed in sample "A-6", in which the manifestation of this trait is greatly influenced by additive gene effects.

The best in terms of the number of fruits per plant were the hybrid combinations: C-25/1 (Ifor) x C-26, A-6 x C-26 and C-26 x C-29, which formed on average 7.0-7.7 pieces of fruits per plant.

Average fruit weight. The results of the analysis of combining ability for this trait show that the highest positive indicators for the effects of GCA (ĝi = 10.44) and variance of GCA ($\sigma^2_{\hat{g}i}$ = 98.20) and SCA (σ^2_{si} = 70.67) were noted in sample A-9 ". A similar phenomenon is also observed in sample "A-6", but the value of the effects of GCA and variance of GCA and SCA were slightly lower compared to sample "A-9". High values of SCA variance were noted for samples "S-26" (σ^2_{si} = 132.08) and "S-29" (σ^2_{si} = 111.77), but the values of variance of GCA were different. For sample "S-26" ($\sigma^2_{\hat{g}i}$ = 14.65) it had a positive value, while for sample "S-29" ($\sigma^2_{\hat{g}i}$ = -10.59) it was negative. Also noteworthy are the samples "C-25/2" ($\sigma^2_{\hat{g}i}$ = 10.16, σ^2_{si} = 66.68) and "C-25/1 (Ifor)" ($\sigma^2_{\hat{g}i}$ = 29.11, σ^2_{si} = 27.57), which showed positive variance indices for GCA and SCA, although the effects of GCA had a negative significance $\hat{g}_i$ = -4,58 and $\hat{g}_i$ = -6,32, respectively).

In the three studied cucumber samples ("C-25/1 (Ifor)", "A-6" and "A-9"), differences in $\sigma^2_{\hat{g}i} < \sigma^2_{si}$ were noted in terms of "average fruit weight", where genes with dominant and epistatic effects that control the inheritance of this trait. In the rest of the cucumber samples, genes with additive effects ($\sigma^2_{\hat{g}i} > \sigma^2_{si}$) for this trait are predominant.

The best in terms of "average fetal weight" were the hybrid combinations: C-26 x C-29, A-9 x A-6 and A-9 x C-25/2, in which fruits weighing 108.2-113.1 g were formed.

The productivity of one plant. There is a wide variability of the GCA and SCA indicators on the basis of "productivity of one plant" with high significance. It was found that samples "A-6" and "A-9" showed high performance in terms of GCA effects (ĝi = 82.1 and ĝi = 78.6) and GCA variances ($\sigma^2_{\hat{g}i}$ = 7176.9 and $\sigma^2_{\hat{g}i}$ = 3989.1) and SCA (σ^2_{si} = 1074.4 and σ^2_{si} = 3579.5). Average positive indices of variance of GCA and SCA are observed in samples "C-25/2" ($\sigma^2_{\hat{g}i}$ = 2072.6, σ^2_{si} = 2702.2) and "C-25/1 (Ifor)" ($\sigma^2_{\hat{g}i}$ = 1447.2, σ^2_{si} = 1443.6), but the effects of GCA were comparatively negative (ĝi = -60.2 and ĝi = -60.3, respectively). The highest values of SCA variance were observed in samples S-29 (σ^2_{si} = 4887.9) and S-26 (σ^2_{si} = 4863.2), although the variance values ($\sigma^2_{\hat{g}i}$ = -1906.3 and σ^2_{gi} = -1841.2) and the effects ($\hat{g}_i$ = -16.7 and $\hat{g}_i$ = -18.5) of GCA had negative mean values.

When comparing the variance of GCA and SCA in the studied cucumber samples "S-25/2", "C-26" and "S-29", the variances of SCA of the characteristic "productivity of one plant" prevail over the values of the variance of GCS ($\sigma^2_{ĝi} < \sigma^2_{si}$), indicating the dominant role in the inheritance of this trait of genes with dominant and epistatic effects, and in the samples "C-25/1 (Ifor)", "A-6" and "A-9", the manifestation of the studied trait is controlled by genes with additive effects ($\sigma^2_{ĝi} > \sigma^2_{si}$).

The best according to signs "average fruit weight" were hybrid combinations: C-26 x C-29, A-9 x A-6 and A-6 x A-9, which had a productivity from a bush from 691 to 769 g.

Conclusion

Based on the studies carried out to study the combining ability of cucumber samples in the system of diallel crosses, the following conclusions can be drawn:

1. When comparing the variance of GCA and SCA in cucumber samples according to the main economically valuable characteristics, it was established:

-according to the traits “the number of days before the opening of the maternal flowers” and “the number of days before the technical ripeness of the fruit”, all the studied cucumber samples have a ratio $\sigma^2_{ĝi} < \sigma^2_{si}$, where the dominant role in the inheritance of this trait also belongs to genes with dominant and epistatic effects;

-the trait “the number of fruits per plant” is controlled by dominant and epistatic gene effects ($\sigma^2_{ĝi} < \sigma^2_{si}$) in almost all cucumber samples, and in sample A-6 - by additive gene effects ($\sigma^2_{ĝi} > \sigma^2_{si}$);

-the phenomenon $\sigma^2_{ĝi} < \sigma^2_{si}$ was noted for the trait "average fruit weight", where the manifestation of the trait is controlled by the dominant and epistatic effects of genes ($\sigma^2_{ĝi} < \sigma^2_{si}$) in the three studied cucumber samples ("C-25/1 (Ifor)", "A-6" and "A-9"), and in the other three samples, additive gene effects ($\sigma^2_{ĝi} > \sigma^2_{si}$) are more important in inheritance;

-the trait “productivity of one plant” is controlled by the dominant and epistatic effects of genes ($\sigma^2_{ĝi} < \sigma^2_{si}$) in three studied cucumber samples, and in the other three samples (“C-25/1 (Ifor)”, “A-6” and “A-9 »). For the manifestation of a trait, genes with additive effects play a special role.

2. Highlighted promising hybrid combinations with the best performance for their use as a source material for the following features:

-the number of days before the opening of the mother flowers: C-25/1 (Ifor) x C-25/2, C-26 x C-25/2, C-26 x C25 / 1 (Ifor), A-9 x C-26 and A-6 x C-25/1 (Ifor);

-the number of days before the technical ripeness of fruits: C-25/1 (Ifor) x C-25/2, A-9 x C-26, A-6 x A-9 and C-26 x C-25/1 (Ifor);

-the number of fruits on one plant: C-25/1 (Ifor) x C-26, A-6 x C-26 and C-26 x C-29;

-average fruit weight: C-26 x C-29, A-9 x A-6 and A-9 x C-25/2;

-productivity of one plant: C-26 x C-29, A-9 x A-6 and A-6 x A-9;

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