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MEASURING OF COMBINING ABILITY, HERITABILITY AND HETEROSIS IN OKRA (ABELMOSCHUS ESCULENTUS L.)

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Annotation: *This research was carried out at the Farms in the Governorate Hasaka - Syria, four cultivars genetically diverse parental of Okra (De1, De2, Sh1 and Sh2) were crossed in all possible combinations employing half diallel mating design, during July 2018 product six hybreds (de1*de2, De1*Sh1,*

*Dee1*Sh2, De2*Sh1, De2*Sh2, Sh1*Sh2).were combered in 2019 season according by Randomyzed Complete Block design with three replecations. And estemate the heterosis and General combining ability (GCA) and specific combining ability (SCA).*

Key words: *Okra, General combining ability (GCA), specific combining ability (SCA).*

ОЦЕНКА КОМБИНАЦИОННОЙ СПОСОБНОСТИ, НАСЛЕДУЕМОСТИ И ГЕТЕРОЗИСА ОКРЫ (ABELMOSCHUS ESCULENTUS)

Аннотация: *Данное научное исследование было проведено на фермерском хозяйстве в гораде Аль–Хасаке - Сирия. Четыре генетически различающихся родительских сорта окры (De1, De2, Sh1 и Sh2) были скрещены во всех возможных комбинациях с использованием метода полудиаллельного спаривания. В июле 2018 г. было получено 6 гибридов de1*de2, De1*Sh1, Dee1*Sh2, De2*Sh1, De2*Sh2, Sh1*Sh2. В 2019 г. по рандомизированному полноблочному плану с тремя репликациями. Была произведена оценка гетерозиса и общей (GCA) и специфической комбинационной способности (SCA).*

Ключевые слова: *Окра, общая комбинационная способность (GCA), специфическая комбинационная способность (SCA).*

1. Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is one of the important vegetable crop, grown for its tender green pods in warld. It's rich from many mineral (protin, calsioum, firon, charpohidrate, fat, and vitamins ....etc) [1, c. 197].

Okra is a polyploid, belonging to the family *Malvaceae* with 2n = 8x = 72 or 144 chromosomes and a self-pollinated crop, the occurrence of out crossing to an extent of 4–19% with the maximum of 42.2% is noticed with the insect assisted pollination [2, c. 173].

The combining ability is the important genetic tool, which provides a guideline for an assessment of the relative breeding potential of the parents or identifying the best combiners, which may be hybridized either to exploit heterosis [3, c. 212].

The magnitude of heterosis provides a basic idea about genetical diversity present in the material. It also helps to choose desirable parents for the development of superior F1 hybrids for exploiting hybrid vigour and Gene action for some of characteristics.

The half diallel crosses is one method was cost for produce hybreds and known the combining abilty between cultivars or lines for plroduct hybreds wishe have high yield and best component characters.

The combining ability is the important genetic tool, which provides a guideline for an assessment of the relative breeding potential of the parents or identifying the best combiners, which may be hybridized either to exploit heterosis or to accumulate fixable genes and detrmined of breeding value [3, c. 212].

The general combining ability and specific combining ability effects are the foundations for any fruitful breeding programme [4, c. 1007]. The common approach of selecting the parents on the basis of performance of their superior Combining ability [5, c. 485].

Al-Mfragy (2006) found that there is significant defferances between five okra cultivars in yield, fruit no./plant, plant hight(cm) and LAI. And the heterosis was positive and significant for yield/plant (52%) and fruit no. (48%) [6, c. 158]. The hetirosis and significant combining abilty showed in yield and yield coponints [7, c. 162]. The variance of GCA and SCA for characters becuse gene action and action between genetic factors and enviromintal factors [8, c. 162]. The hetirosis for okra green yield was 62.12% [9, c. 32].

Objective of Study:

Several approaches are available for: 1) - Product of F1 and select the best hybreds; 2) - study the heterosis; 3) - study of general and spicific combining ability.

2. Materials and Methods:

Four cultivars genetically diverse parental of okra (De1, De2, Sh1 and Shh2) were crossed in all possible combinations employing half diallel mating design.

The present study was conducted at Al-Haska, during July 2018- 2019.

In the 2018 crossing the pairent by used Half-diallel Cross, The crossing results 6 hybreds (p(p-1)): (de1*de2, de1*sh1, de1*sh2, de2*sh1, de2*sh2, sh1*sh2).

The soile analysis was (pH=7.9, Ec=1.3 mm/cm, selt (40), sand (19), (41).

In he socend seaeson (2019) the hybreds grow Syria recorded on randomized complete block design with three replication, planting distance of 60 cm x 30 cm was maintained. And add the 25 kg super phosphat, 46% Uria and 50% Potacum slphate.

The following quantitative traits viz., days to first flowering, plant height (cm), fruit length and diameter (cm), no.of fruit per plant, and fruit yield ton/ha. Heterosia and combining abilty were computed by used of analysis of variance F test and $LSD_{0.05}$ [10, c. 657].

Broad sense Heritability estemated by used formola: **(**σ^2_g / σ^2_p) x100 [11, c. 119].

Genetic Advance as percentage (GA %):

$$\mathbf{GA\%} = \frac{k\sigma^2_g}{\sigma^2_p} \text{ X } \frac{100}{\overline{X}}$$

Were k=2.06 in selectin density 5%

General and spisific ability were computed by fixed model 4 method [12, c. 463]:

.

$$S_g = \frac{1}{{}^2P_i}\sum_i \left(X_{ij} + X_{ji}\right)^2 - \frac{2}{P^2}X_{..}^2,$$

$$S_s = \frac{1}{2}\sum_i \sum_j X_{ij}\left(X_{ij} + X_{ji}\right) - \frac{1}{{}^2P}\sum_i \left(X_{ij} + X_{ji}\right)^2 + \frac{1}{P^2}X_{..}^2,$$

$$S_n = \frac{1}{2}\sum_i \sum_j X_{ij}\left(X_{ij} - X_{ji}\right)^2.$$

The $\sigma^2_{GCA}/\sigma^2_{SCA}$ were used for determide the gene action

$\frac{\sigma^2_{GCA}}{\sigma^2_{SCA}} > 1$ additive gene acton

$\frac{\sigma^2_{GCA}}{\sigma^2_{SCA}} < 1 non\ additive\ gene\ action$

$\frac{\sigma^2_{GCA}}{\sigma^2_{SCA}} = 1\ additive\ and\ non\ additive\ gene\ action$

The Heterosis computed by used med pairents:
H(MP) = [(F1-MP)/MP]100

3. Results and Descution

In this study we puting the data in table1 showed some phynologic, phynotopc and yield of Okra, as soon as value of LSD in 5% probability levels.

Table 1.

The chracteristics studed

Genotype	First flowering	Plant hight(cm)	LAI	Fruit length(cm)	Fruit diamater (cm)	No. Of ftuit/plant	Yield fruit (ton/ha)
De1	72	165	5.6	4.87	7.3	38	5.561
De2	68	164	5.7	5.99	6.7	36	5.158
Sh1	75	180	6.8	6.21	4.7	34	5.297
Sh2	76	160	6.8	6.25	3.7	30	6.054
De1*De2	61	210	12.4	8.14	6.3	60	7.556
De1*Sh1	64	240	13.0	9.27	5.0	52	9.154
De1*Sh2	63	200	13.1	10.4	5.3	58	8.601
De2*Sh1	62	220	13.5	10.75	5.0	55	8.291
De2*Sh2	59	215	12.7	10.02	4.7	57	8.176
Sh1*Sh2	67	225	14.6	11.57	5.7	63	10.182
$LSD_{0.05}$	2.4	4.1	0.4	0.9	0.2	2..8	0.120

3.1. First flowering

The signifecant differances showed in first flowering. The earler hybred was De2*Sh2 (59) days and the next hybred was De2*Sh1 (62) days, but the late hybred was Sh1*Sh2 (67) days.

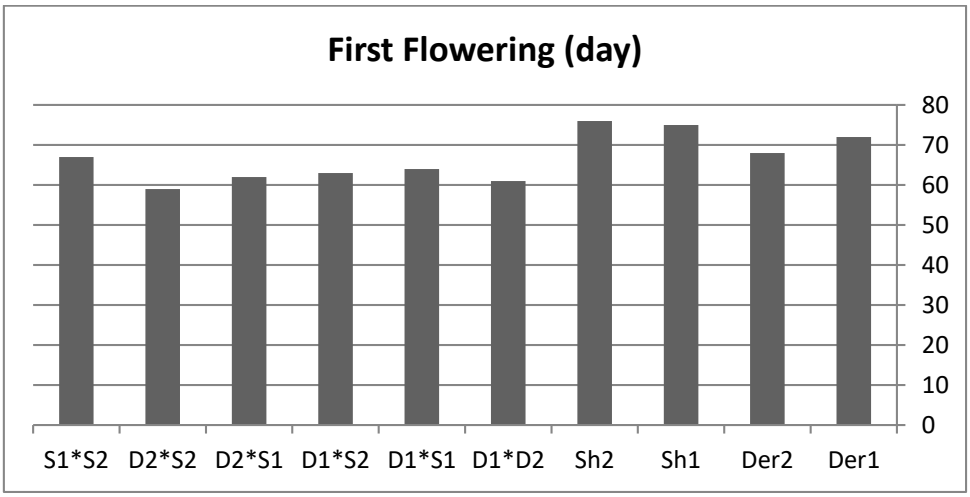

Figure 1. First flower.

3.2. Plant hight (cm)

From table (1) there is significant defferances betwwn hybreds in The Plant hight. Increase the hight showed in De1*Sh2 (240cm) but the shorter hybred was De1*Sh2 (200 cm).

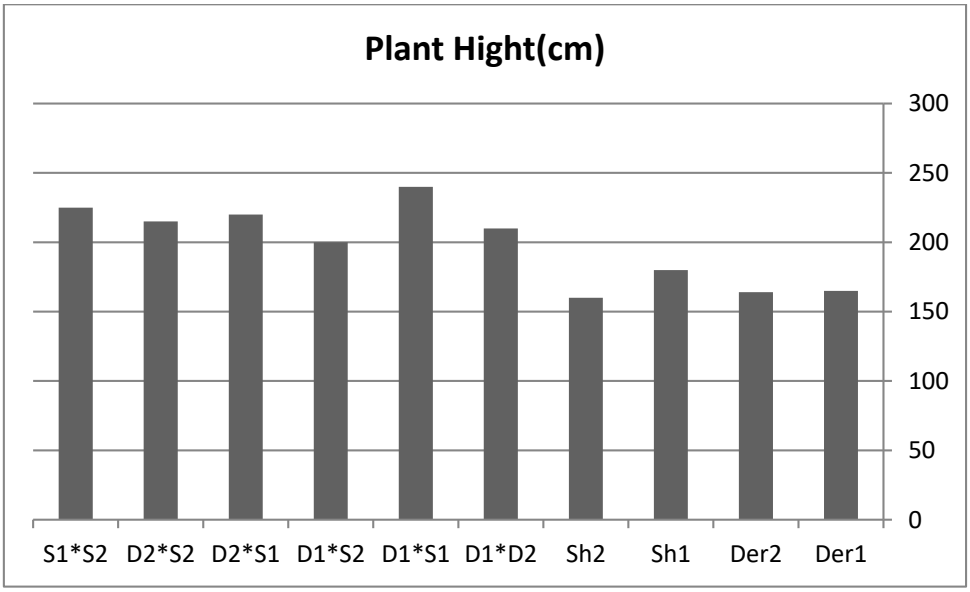

Figure 2. Plant hight(cm).

3.3. Leaf Area Index (LAI):

From table (1) there is significant defferances betwwn hybreds in The LAI and the best hybred was Sh1*Sh2 (13.5) but decrese it in the hybreds De1*De2 and De2*Sh2 (12.4 and 12.7) respictively.

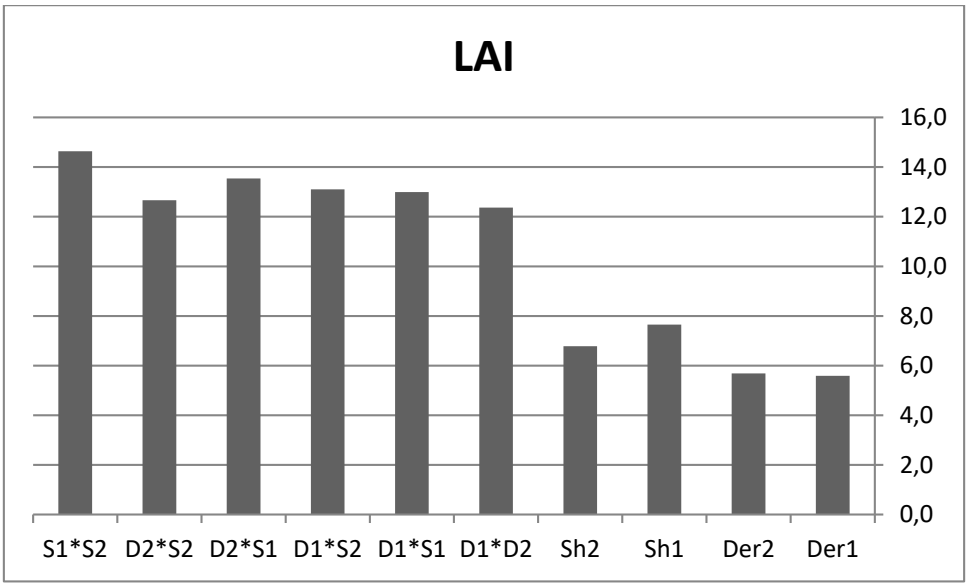

Figure.3. Leaf Area Index (LAI).

3.4. Fruit length (cm)

There is signifecant differances between hybreds in fruit length were incresed significantly combered with onther hybreds Sh1*Sh2 (11.57) cm where the hybred De1*Sh2 and De2*Sh1 were 10.7 and 10.4cm respectively.

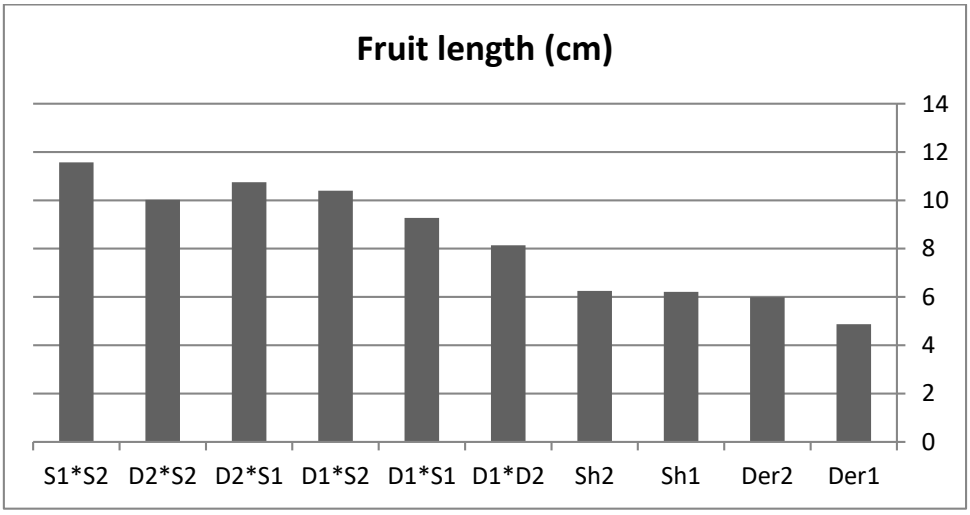

Figure.4. Fruit length (cm).

3.5. Fruit diameter (cm)

There are significant differances between hybreds for fruit diameter. The range of fruit dimeter was 4.7-6.3cm for De2*Sh1 and De1*De2.

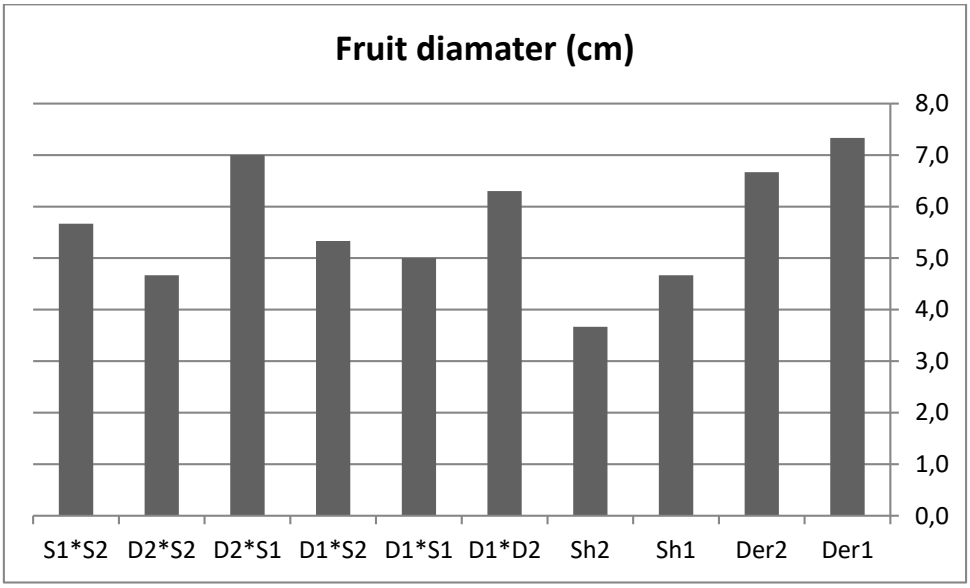

Figure.5. Fruit dimeter (cm).

3.6. Number of fruit/plant

There is signifecant differances between hybreds for fruit no./plant. Of fruit was 57-63 fruits by De2*Sh2 and Sh1*Sh2.

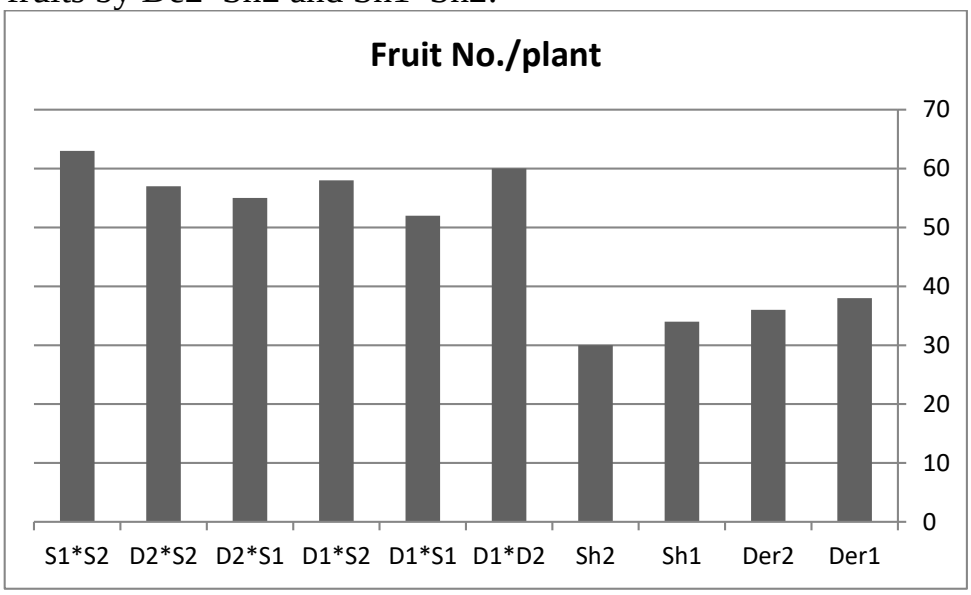

Figure.6. Fruit Number in plant.

3.7. Green fruit yield (ton/ha)

The result showed that signifecant differances between hybreds but the yield incresed in Sh1*Sh2 was its yield (10.182) ton/ha.

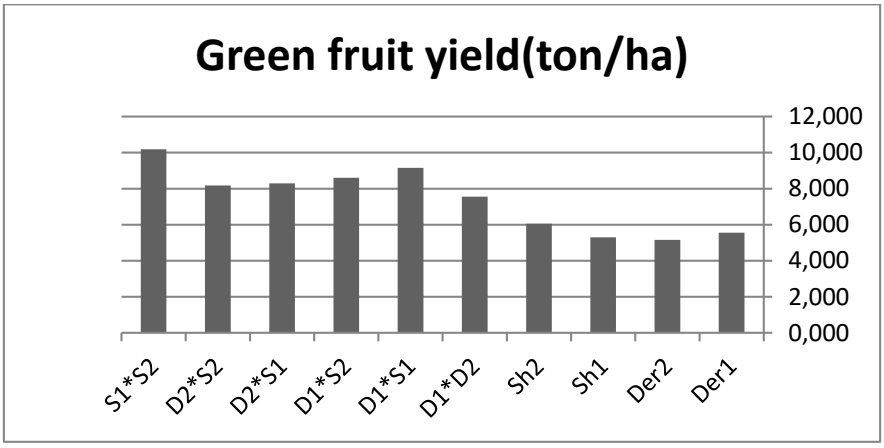

Figure.7. Green fruit yield (ton/ha).

3.8. Heterosis

The result of statistical analysis showed that F1's exhibited significant heterosis for all characters. All hybrid gave the negative value for number of days to flowering, the high value was (-18.1) for De2*Sh2. The hybrid (Sh1*sh2) gave the highest heterotic value for the number of fruit per plant (72.7) and yield fruit (79.4). The hybrid (De1*Sh2) gave the highest value for the fruit length (87.1), the hybrid showed (Sh1*Sh2) highest value for the fruit diameter and the hybrid (De1*De2) gave the highest value for the LAI (119.4).

Table 2.

Heterosis for characterestics in the hybreds

Genotype	First flowerin	Plant hight(cm)	LAI	Fruit length(cm)	Fruit diameter (cm)	No. Of fruit/plant	Yield fruit (ton/ha)
De1*De2	-12.9	27.7	119.4	49.9	-10.0	62.2	41.0
De1*Sh1	-12.9	39.1	94.7	67.3	-16.7	44.4	68.6
De1*Sh2	-14.9	23.1	81.5	87.1	-3.0	70.6	48.1
De2*Sh1	-13.3	27.9	41.4	76.2	23.5	57.1	58.6
De2*Sh2	-18.1	32.7	-0.1	63.7	-9.7	72.7	45.9
Sh1*Sh2	-11.3	32.4	12.2	85.7	36.0	96.9	79.4

3.9. Combining Ability

The character wise estimates of general combining ability effects for each parent are presented in table 3 and indicate that the merit of the parents differs significantly for different characters. Dirict that genetic deverse for these characters, and from σ^2GCA /σ^2SCA showed that the additive gen action was effect for LAI, Capsule No./plant, and yield. However the nonadditive action effect for fllwering, long and girth fruit, where the additive and nonadditive were effect to plant hight. Accept with Al-Mfargy (2006) results [6, c. 158].

Table 3.

General and spicific combining ability

Characters	$_{GCA}^2\sigma$	$_{SCA}^2\sigma$	$_{SCA}^2\sigma$ /$_{GCA}^2\sigma$	Gene action
Firest flowering	*3.74	3.92	0.95	Non additive
Plant hight(cm)	**60.3	60.2	1.00	Additive and non additive
LAI	*2.45	2.1	1.17	Additive
Fruit length	*2.13	24.00	0.09	Non additive
Fruit diameter	*3.72	4.11	0.91	Non additive
No. Of fruits/plant	*3.22	2.35	1.37	Additive
Green yield(ton/ha)	*29.36	21.35	1.38	Additive

3.10. Broad since Heritability

From table (4) Showed that, the GV less than phv and the highly heritability for plant hight and capsules No./plant (74.78 and 74.34) respictivily. The heritability for Green fruit yield (ton/ha) was meiatly equal (51.58) % put it was low for LAI (15.65) %.

On the other hand, the GA% was good development for Fruit length (17.37%) this is usefuly for selection hybreds.

Table 4.

Genetic, Phynotopic, Heritability% and Genetic advance as percint%

Charachters	GV	PhV	h^2 %	GA%
First Flowering (days)	3.15	4.36	72.25	2.23
Plant hight(cm)	66.89	89.45	74.78	0.78
LAI	0.15	0.98	15.65	3.07

Fruit length(cm)	0.88	1.25	70.40	17.37
Fruit diameter(cm	0.26	0.87	29.89	10.93
Fruit No./plant	4.65	6.26	74.34	3.17
Green fruit yield (ton/ha)	45.60	88.40	51.58	14.35

4. Conclusion:

1. The hybreds showed that earler flowering than its parents
2. Highly haterosis for LAI
3. The capsules yield was highly 10.82 ton/ha for Sh1*Sh2
4. The genitic additive principle fr girth, long and No. Of Capsule
5. Highly h2 for flowering.

Recomandation:

1. Re crossing and testing the hybreds in other enveromint for knowleg genetic stability.
2. Care of the Sh1 and Sh2.
3. Experment onther cultivars for hybreds production

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