Bulgarian Journal of Agricultural Science, 22 (No 6) 2016, 982–986
Agricultural Academy

APPLICATION OF THE SUBJECTIVE INDEPENDENT METHOD FOR EVALUATION OF HYBRID MATERIALS SESAME (*SESAMUM INDICUM* L) IN THE DIRECTION OF MECHANIZED HARVESTING

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Abstract

STAMATOV, St., M. DESHEV, St. ISHPEKOV and R. ZAYKOV, 2016. Application of the subjective independent method for evaluation of hybrid materials sesame (*Sesamum indicum* L) in the direction of mechanized harvesting. *Bulg. J. Agric. Sci.*, 22: 982–986

This investigation is subjective independent method for evaluating the susceptibility of sesame genotypes for mechanized harvesting. The values obtained numerical indicators to classify genotypes according to their suitability for threshing with or without destroying the capsules. The results show that the obtained hybrid materials whose indicator of suitability for threshing without breaking the boxes surpasses 4.7 times that of the variety Aida and 9.5 times variety Nevena. They were received and hybrids with better suitability for threshing with the destruction of capsules.

The investigation estimates efficiency of the team and ways of inheritance of varietal traits that improve suitability for mechanized harvesting sesame genotypes.

Key words: sesame, breeding, mechanized harvesting

Introduction

Several international forums recognize that 99% of the world sesame is harvested by hand (Langham D. et all, 2002) and, if not mechanized, then in the next 25-30 years, his production will drop significantly (FAO, 2002).

Difficulties associated with the mechanized harvesting due to the type of fruit capsules. Common varieties in the world are with shattering capsules and scattered ripe seeds in the field. Sesame forms that can be harvested mechanized created by company Sesaco, USA (Langham, 2000; Langham et. al, 2001; Langham et. al, 2001) and Turkey (Uzun et. al., 2003).

In recent years in IPGR – Sadovo has a sesame forms that retain their seeds mature (Georgiev et al., 2014; Stamatov et al., 2014). They are characterized by two varietal marks, which reduce spillage when ripe. One sign is “attached placenta” and the other is as a fruit capsules, and in particular the extent and location of its narrowing.

Is not defined the impact of both varietal sings on retaining seeds in boxes shaking the plants from wind and their submission in harvesting machine. It is not known and the possibility of threshing of newly created genotypes by crushing or without crushing capsules. Both variables determine the susceptibility of genotypes for mechanized harvesting without significant losses.

The purpose of this study was to follow the mode of transmission in both sings, depending on the used parent’s force of their expression in the seed, and the effectiveness of the methods of selection.

Materials and Methods

Studied 41 offspring of F1, F2 and F7 generation are the following parents:

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➢ Varieties Aida, Nevena and Valya, which are characterized by existence of placenta attached;

➢ Variety Victoria and breeding lines Sadovo Sadovo 3959 and 3962 that are genotypes with non-shattering in capsules;

➢ Varieties Sadovo 1, Sofia and Elena, which is characterized by shattering capsules.

Survey covers progeny of F_1 generation of cross ♀Aida x ♂ Sadovo 3959. Tested are progeny of F_1 and F_2 generations of cross ♀Nevena x ♂ Sadovo 3959. In the rights and reciprocal cross between the varieties Victoria and Sadovo 1 tested progeny F_7 generation. F_7 generation progeny of a cross ♀Sadovo 3962 x ♂ Sadovo 1 and again deep shattering parent of F_1 progeny scheme (♀Sadovo 3962 x ♂ Sadovo 1) × 1 and Sadovo (♀Sadovo 3959 x ♂ Sofia) x Sofia. Used a pedigree breeding scheme (Enchev and Chilikov, 1984) team of hybrid materials.

The evaluation of the susceptibility of sesame capsules for mechanical harvesting of the seeds is carried out by specially developed subjective independent methods (Ishpekov et al., 2015b). For each genotype studied define three dimensionless numerical indicators:

➢ I_1 – an indicator of the dispersion of seeds at shaking the plants;

➢ I^2 – an indicator for the retention of the seeds in the box, due to the specificities of its shape;

➢ I_3 – an indicator of the strength of the relationship between the seeds and placenta.

Genotypes with high index value i_1 are susceptible to mechanized harvesting, due to seed spillage. These high values of the index i_2 are suitable for harvesting by threshing by crushing capsules. The high value of the index i_3 shows suitability for harvesting the seeds by inertial effect without destroying the capsules (Ishpekov et al., 2015a).

Results and Discussion

Selection improvement measures with Bulgarian forms sesame shows progress in terms of increasing the ability of new breeding materials to retain ripe seeds in capsules. As a consequence of proper approach when selecting the team and parents of hybrid offspring have increased the index values due to changed anatomical features sesame capsules. Table 1 hybrid materials are sorted according to the index values i_2 and i_3. It is evident that much of the hybrids outperform Aida, Nevena and Valya and both indices. The excess of the index i_3 reaches 4.7 times compared to Aida and 9.5 times compared Nevena, which means that the new offspring are significantly more susceptible to the threshing without destroying the capsules.

Table 1
Descending order of test genotypes in the values of i_2 and i_3

№	Variety/ progeny	i_2	№	Variety/ progeny	i_3
1	F_2_38	0.590	1	F_2_36	2.481
2	F_2_23	0.533	2	F_7_27	2.464
3	F_4_22	0.525	3	F_7_30	2.233
4	F_2_19	0.474	4	F_7_14	2.143
5	F_1_16	0.444	5	F_7_6	2.069
6	F_1_66	0.415	6	F_1_6	1.920
7	F_7_30	0.406	7	F_2_23	1.556
8	F_7_19	0.405	8	F_2_52	1.455
9	F_7_14	0.392	9	F_1_8	1.455
10	F_1_40	0.392	10	F_7_7	1.200
11	F_1_64	0.380	11	F_1_18	1.103
12	F_2_41	0.370	12	F_1_40	1.029
13	F_2_32	0.364	13	F_1_16	0.970
14	F_2_25	0.364	14	F_1_29	0.936
15	F_1_18	0.344	15	F_2_19	0.931
16	F_2_52	0.317	16	F_4_22	0.906
17	F_1_8	0.317	17	F_1_55	0.897
18	Aida	0.300	18	F_1_54	0.833
19	F_1_54	0.294	19	F_1_12	0.778
20	F_1_29	0.820	20	F_1_64	0.769
21	F_7_24	0.253	21	F_2_32	0.765
22	F_1_68	0.246	22	F_2_25	0.765
23	F_2_44	0.239	23	F_1_7	0.765
24	F_2_39	0.239	24	F_1_66	0.758
25	Nevena	0.235	25	F_7_19	0.733
26	F_1_55	0.222	26	F_1_26	0.714
27	F_1_12	0.208	27	F_2_19	0.649
28	F_7_6	0.203	28	F_2_38	0.632
29	F_2_36	0.190	29	F_2_24	0.568
30	F_7_27	0.183	30	F_1_68	0.543
21	F_7_7	0.179	21	Aida	0.529
32	F7_17	0.171	32	F_7_24	0.478
33	F_1_6	0.159	33	F_2_44	0.462
34	F_2_24	0.150	34	F_2_39	0.462
35	Valia	0.118	35	F_2_41	0.321
36	F_1_7	0.071	36	Nevena	0.260
37	F_1_26	0.059	37	F_7_17	0.200
38	F_1_37	0.057	38	F_1_65	0.196
39	F_7_26	0.050	39	Valia	0.128
40	F_1_65	0.017	40	F_1_37	0.120

The correlation coefficient between the values of the two indexes i_1 and i_2 is 0.198 from which it follows that there is a linear relationship between them. On the one hand this is an advantage of the method for preparing them. On the other hand this facilitates team offspring of both groups – threshing by destroying capsules and threshing without their destruction (Ishpekov et. al., 2015a).

I_3 Index quantifies the suitability of genotype to harvest the seeds without shattering capsules, but can also be used as a criterion for the strength of the relationship between the seeds and placenta.

In crosses with parents with attached placenta to be used as a maternal form and those with non-shattering capsules is used as a father show that successfully produce forms with seeds fastened to the placenta at ripening. The values obtained for the index i_3 progeny generations F_1 and F_2 of a cross ♀Nevena x ♂ Sadovo 3959 show reinforcing the relation between the seeds and the placenta in the F_2 generation compared to F_1. (Table 2).

Table2
I3 index for generations F_1 and F_2

Progeny	i_3
F_2 ♀Nevena x ♂3959	2.481
F_2 ♀ Nevena x ♂3959	1.556
F_2 ♀ Nevena x ♂3959	0.931
F_1 ♀ Nevena x ♂3959	0.769
F_1_♀ Nevena x ♂3959	0.196

The sign "attached placenta" manifests itself in strong extent in some of the progeny of the F1 generation from the crossing ♀Aida x ♂ Sadovo 3959 (Table 3). Successful crosses in which appears in the placenta attached progeny are found between parents and shattering with non-shattering in boxes. Examples are the progeny of F7 generation of crosses ♀Sadovo 1 x ♂ Victoria index i3 = 2.464. and ♀Elena x ♂ Victoria index i3 = 2.233.

Table3
Index generation i3 for F1

Progeny	i_3
♀Aida x ♂3959	1.920
♀ Aida x ♂3959	1.455
♀ Aida x ♂3959	1.103
♀ Aida x ♂3959	0.970
♀ Aida x ♂3959	0.936
♀ Aida x ♂3959	0.778
♀ Aida x ♂3959	0.765
♀ Aida x ♂3959	0.714

In breeder improvement works with sesame seeds often need to be made of shattering saturating crosses parent to increase splitting the top of the capsule in their descendants. The question arises whether this way while not weakening the link between the seeds and placenta. In researched progeny of F7 generation of saturation crosses the formula (♀Sadovo 3962 x ♂ Sadovo 1) × 1 and Sadovo (♀Sadovo 3959 x ♂ Sofia) x Sofia received values i3 1.2 and 2.07.

Minutes in of progeny in terms of the strength of the placenta until now have operated subjective. The merits of the method can be judged by the results of Table 4. They show that the subjective side of the hybrid materials leads to a miscalculation very often. Progeny of a cross ♀Sadovo 1 x ♂ Victoria show large differences. For the first progeny index i3 = 2.464 and the second – i3 = 0. That dependence is observed in progeny from the crossing Defense ♀Viktoriya x ♂Elena where both progeny differ significantly index reflecting the strength of the attached placenta. The method Pedigree requires side of pedigree in the offspring F2 generation. But Table 4 shows that the subjective side of progeny from a cross ♀Nevena x ♂3959 also ineffective.

Table 4
I3 index for generations F2 and F7

Progeny F_7	i_3
♀Sadovo1 x ♂Victoria	2.464
♀ Victoria x ♂Elena	2.233
♀3850x ♂Sofia	2.143
(♀3959x ♂ Sofia) x♂ Sofia	2.069
(♀3962x ♂ Sadovo1)x♂ Sadovo1	1.200
♀4047 x ♂ Sofia	0.733
♀ Victoria x ♂ Elena	0.478
♀3962 x ♂ Sadovo1	0.200
♀ Sadovo1 x ♂ Victoria	0.000
Progeny F_2	
♀Nevena x ♂3959	2.481
♀ Nevena x ♂3959	1.556
♀3959 x ♂ Nevena	1.455
♀ Nevena x ♂3959	0.931
♀ Nevena x ♂3959	0.765
♀ Nevena x ♂3959	0.765
♀ Nevena x ♂3959	0.649
♀ Nevena x ♂3959	0.632
♀ Nevena x ♂3959	0.568
♀ Nevena x ♂3959	0.462
♀ Nevena x ♂3959	0.462
♀ Nevena x ♂3959	0.321

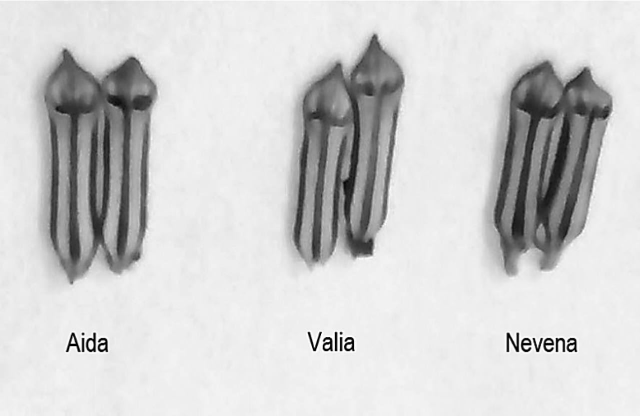

Fig. 1. Capsules with different positions along their narrowing

Narrowing capsules also affects the retention of the seed capsules when ripe. Photo 1 show that the variety Aida narrowing capsules immediately below its peak and impedes the release of seeds in it. Narrowing capsules variety of Nevena is in the middle of the capsules and also has inhibitory effect on seeds but is less pronounced than at Aida, which is confirmed by their values i2 (Figure 1). Its value for Valya

Table 5
I2 index for generations F2 and F7

Progeny F_7	i_2
♀Victoria x ♂Elena	0.406
♀4047 x ♂Sofia	0.405
♀3850x ♂ Sofia	0.392
♀ Victoria x ♂ Elena	0.253
(♀3959x ♂ Sofia) x♂ Sofia	0.203
♀Sadovo1 x ♂ Victoria	0.183
(♀3962x ♂ Sadovo1)x♂ Sadovo1	0.179
♀3962 x ♂ Sadovo1	0.171
♀Садово 1 x ♂ Victoria	0.050
Progeny F_2	
♀ Nevena x ♂3959	0.590
♀ Nevena x ♂3959	0.533
♀ Nevena x ♂3959	0.474
♀ Nevena x ♂3959	0.370
♀ Nevena x ♂3959	0.364
♀ Nevena x ♂3959	0.364
♀3959 x ♂ Nevena	0.239
♀ Nevena x ♂3959	0.239
♀ Nevena x ♂3959	0.190
♀ Nevena x ♂3959	0.150

Table 6

Descending order of the tested genotypes in the values of i_1

№	Progeny	i_1
1	f7_26	20.000
2	f1_37	5.222
3	f1_65	4.545
4	Valia	3.571
5	f7_17	2.200
6	Nevena	1.520
7	f1_26	1.118
8	f2_24	1.029
9	f1_7	1.000
10	f2_44	0.966
11	f2_39	0.966
12	f2_41	0.947
13	f7_24	0.904
14	f1_68	0.821
15	Aida	0.733
16	f1_12	0.641
17	f1_55	0.528
18	f1_54	0.467
19	f7_7	0.435
20	f2_32	0.429
21	f2_25	0.429
22	f1_29	0.422
23	f2_19	0.419
24	f1_64	0.408
25	CO19	0.405
26	f1_66	0.381
27	f2_38	0.319
28	f1_18	0.281
29	f1_40	0.268
30	f1_6	0.259
31	f1_16	0.250
32	f2_19	0.244
33	f4_22	0.220
34	f2_52	0.200
35	f1_8	0.200
36	f7_6	0.187
37	f7_27	0.155
38	f2_36	0.146
39	f2_23	0.045
40	f7_14	0.038
41	f7_30	0.021

is the lowest compared to varieties of the image which has meant that her form of capsules does not affect the retention of seeds. Experimental results show that the constriction of the capsules is located closer to the tip, the less is its splitting and dispersal of seeds.

Capsules with high values of i2 produce parental couples Sadovo 3959, Nevena, Victoria and Helena. The index in the progeny of these parents is from 0.590 to 0.344. Variety Aida and Valya used in parental couples passed on to progeny deeper cleavage of the capsules and their narrowing is situated lower, which reduces the value of i2.

After the appearance of the sign "narrowing of the capsules below bursting peak" is not found its gain in the next progeny. Saturated of split parent crosses with respect to this feature leads to a further cleavage at the top of the capsules and less retention of the seed. In the progeny of crossings (♀Sadovo 3962 x ♂ Sadovo 1) × 1 and Sadovo (♀Sadovo 3959 x ♂ Sofia) x Sofia index i2 is of little value, respectively 0.203 and 0.179. The analysis results speak for monogenic this quality sing.

The effectiveness of the jersey performed a subjective criterion in relation to the constriction of the capsules can be seen from the results presented in Table 5. It is evident that in the team by this sign have disadvantages.

The selected progeny that have lower values of i2 and i3 indices are characterized by high values of the index i1. These progeny are unsuitable for mechanized harvesting because disperse their seeds ripening. In their varietal signs and placenta attached narrowing of the capsules are not observed. Relatively high values of i1 seed of advanced generations, and for Aida. Nevena and Valya show once inferiority of the subjective criterion which makes the side, Table 6.

Conclusions

The application of subjective independent method for evaluating the susceptibility of sesame genotypes for mechanized harvesting seeds significantly facilitates jersey of hybrid progeny and makes it much more effective.

As a result of selection improvement efforts was achieved a fivefold increase of the indices that characterize the susceptibility threshing through destruction and without breaking the boxes of new hybrid progeny than those of varieties Aida. Nevena and Valya

The sign "attached placenta" is transmitted successfully progeny with parents Aida. Nevena. Victoria and Sadovo 3959. It is amplified in subsequent generations F1.

Increasing the cleavage of the top of the capsules does not lead to a weakening of the attached placenta.

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Received January, 25, 2016; accepted for printing November, 1, 2016