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SUSCEPTIBILITY OF 13 OKRA GENOTYPES TO INFESTATION WITH SOME PESTS AS CORRELATED TO LEAF MORPHOLOGY

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ABSTRACT

The present research work aimed to differentiate between thirteen okra genotypes from the point of its susceptibility to infestation by some sucking pests(*Empoasca discipiens* (Paoli) , ,*Aphis gossypii* (Glover);,*Bemisia tabaci* (Genn.),*Tetranychus urticae* (Koch) and, *Liromyaza trifolii* (Burg)) during two summer plantation 2010 and 2011. Results clearly indicated that there was significantly positive correlation between the number of hairs on leaf lamina and population of whiteflies (r= +0.944**) and mites (r=+ 0.983**). Hairiness of the leaves influences the population of aphids, leaf miner, whiteflies, mite and leafhopper populations to the extent of 82,85.,89, 94 and97 per cent, respectively. There was significantly negative correlation between pest population and mid-vein hair density for, leaf miner(r =-0.928**) , aphids (r= -0.938**) and leafhopper (r= -0.985**), thus it appears to be an important factor in imparting biophysical resistance in okra against these pests. Whereas, significantly positive correlation was observed between population of whitefly, mite, and mid-vein hair density (r= +0.967**and+0.968**) favoring to the whitefly and mite population buildup. Influence of mid-vein hair density on different sucking pests population e.g., leaf miner, aphids, , whiteflies, mite and leafhoppers was to the extent of 80, 89, 94,97 and 98 per cent, respectively. Overall impact of midrib thickness on the population of some pests e.g., whiteflies, aphids, leaf miner , mite and leafhoppers was to the extent of 64,72,75, 80and 88 per cent, respectively . However, from the present study on interactions of okra genotypes against some sucking pests, it can be concluded that the genotypes Balady(B),Mansoura Red (HM), are susceptible for (aphids, mites, whitefly, leaf miner and leafhopper, respectively). While genotypes Roomy (R), Str.L1, Str.L3, Str.L4, Str.L6 and Str.L8 were considered as moderate. In the mean time, Str.L9, Str.L5, Cairo Red (HK),Str.L6 and Str.L7, are resistant against (aphids, mites, whitefly, leaf miner and leafhopper, respectively) and can be recommended for cultivation in areas where high incidence of these pests are noticed.

Keywords: Okra, pests, genotypes, susceptibility, resistance, morphological characters.

INTRODUCTION

Vegetables consist a major part of food consumed by the Egyptian population. One of the important vegetable crops in Egypt is okra (*Abelmoschus esculentus* (L.) Moench.), which is a good source of protein, vitamin and mineral elements needed for the development and maintenance of human body. The fruit also lend itself well to freezing and canning products (Dike, 1983).

Foliage of okra plants are known to provide good sources of fodder for livestock (Ambekar and Kalbhor, 1981). However, okra is subjected to be attacked by a variety of insect pests which are responsible for tremendous reduction in its yield and hinder its quality such as aphids, whiteflies and thrips (El-Khawas, 2005 and Saif Ullah &Aziz,2012). The cotton aphid, *(Aphis gossypii* Glov.) is one of the most widespread species of aphids, and displays a large range of host-plants, covering very different families. This impressive behavior made it a major pest of numerous crops (Fuchsberg *et al.*, 2007). In spite of large phenotypic variabilities in cultivated okra, many previous analyses have shown a rather low level of genetic diversity. Hince, it is useful to identify resistant and high yielding okra varieties to be used as resistat source of genetic improvement. So, the acchievement of sustainable control of the pest in a convenient economical and safety eco-frindly manner is possible. Thus, the aim of this study is screening the sensitivity of some okra genotypes against some pests and know the influence of some morphological characters such as number of hairs on leaf lamina, number of hairs on midrib and thickness of the midrib.

MATERIALS AND METHODS

1- Expermental field.

The present study was carried out during the two summer seasons 2010 and 2011 at Baramon experimental farm of Horticultural Institute (Mansoura Research Station, ARC, Egypt). Four local varieties and nine newly selected strains were tested. Selection of the okra strains was conducted using a pedigree method in a previous work done by Soher Elgendy in 2009 (Elgendy,2012) as shown in Table (1). The experimental design was a complete randomized block with three replicates. Each plot area was 12 m^2 including 4 rows, each of 4 m length and 75 cm width and one plant per hill 20 cm apart. Growing plants were thinned to leave one plant per hill just before first irregation. The agricultural practices were regularly done according to the general program of okra cultivation Agriculture. Studies on various aspects of some pests of okra, were carried. Table (2) represents leaf morphology of 13 different okra genotypes plants under study.

2- Interaction of some okra genotypes against some pests

Crop was raised by following all the recommended agronomic practices.

Observations were made on the number of leafhopper,*Empoasca discipiens* (Paoli) ,the aphid,*Aphis gossypii* (Glover);the whitefly ,*Bemisia tabaci* (Genn.) the two spotted spider mite,*Tetranychus urticae (*Koch) and The serpentine leaf miner, *Liromyaza trifolii (*Burg) for which five plants were selected randomly in each plot and they were tagged. From each tagged plant three random leaves from top, middle and lower canopy were taken. Ten leaves were randomly collected, kept into polyethylene bags, tightly closed with rubber bands and transferred to laboratory for examination using a stereomicroscope .Insects and mites were counted and recorded.. Observations on number of hairs present on the leaf lamina and on midrib of the13 genotypes were made, under the microscopic field which was standardized and expressed as number of hairs per square millimeter (mm^2) and thickness of the mid vein determined with venires calipers.

3- Statistical analysis

Data were statistically analyzed using the analysis of variance and the simple correlation according to the method of (Snedecor and Cocharn, 1967).

Table 1: The pedigree for obtaining the nine selected strains (Elgendy,2012).

No	Parents		F1	F2	Selected Strains
	female	male			
1	Roomy (R)	Balady (B)	(R x B)	F2 (1)	Str.L1
2 3 4 5	Roomy (R)	Mansoura Red (HM)	(R x HM)	F2 (2)	Str.L2 Str.L3 Str.L4 Str.L5
6	Mansoura Red (HM)	Balady (B)	(HM x B)	F2 (3)	Str.L6
7	Mansoura Red (HM)	Cairo Red (HK)	(HM x HK)	F2 (4)	Str.L7
8 9	Cairo Red (HK)	Roomy (R)	(HK x R)	F2 (5)	Str.L8 Str.L9

Where: R : Roomy cultivar , B: Balady cultivar, HM: Mansoura Red Cultivar and HK: Cairo Red Cultivar.

Table(2): Leaf morphology of 13 different okra genotypes plants under study.

RESULTS AND DISSCUSSION

Genotypes	Original cultivars	Morphological description of leaves
Variety	Roomy	Green, ,smooth,tall4-5parts
	Balady	Green , , smooth , medium in tall,
	HM	Green red, ,spiny,, medium in tall
	HK	Green red, ,smooth, tall4-5parts
Lines	Str.L1	Green, smooth, medium in tall
	Str.L2	green , smooth , medium in tall , ,
	Str.L3	Green, medium in tall, medium spiny
	Str.L4	Green red, short, l,smooth
	Str.L5	Green, smooth ,medium in tall, ,
	Str.L6	Green red, spiny , tall4-5parts
	Str.L7	Green red, smooth, medium in tall,
	Str.L8	Green red, medium in tall, smooth,
	Str.L9	Green, smooth, short,1part

Population density of leafhopper,*Empoasca discipiens* (Paoli) ,the aphid,*Aphis gossypii* (Glover);the whitefly, *Bemisia tabaci* (Genn.) the two spotted spider mite,*Tetranychus urticae* (Koch) and The serpentine leaf miner, *Liromyaza trifolii* (Burg) attacking okra plants was estimated on some okra genotypes during the two successive seasons of 2010 and 2011.

Generally, as shown in Table (3) , no real differences were noticed or recorded for the distribution of main pests attacking okra plants during the two successive seasons of this study. Aphid represented the most pest attacking okra with a ratio around 44 % followed by mite (24%),While whitefly and leaf miner (15%) each . Leafhopper represented the lowest occurrence (2%) in this respect.

Table (3). The total number and occurrence percentages of collected sucking pests associated with okra genotypes during two successive summer seasons (2010 and 2011) .

The main pests	2010		2011		Mean	
	Total number	Occurrence %	Total number	Occurrence %	N	%
Aphis gossypii Glov.	3893	43.7	3796	43.9	7689	43.8
Tetranychus urticae (Koch)	2104	23.6	2031	23.5	4135	23.6
Bemisia tabaci (Genn.)	1363	15.3	1341	15.6	2704	15.4
Liromyaza trifolii (Burg)*i*	1339	15.1	1268	14.7	2607	14.9
Empoasca discipiens (Paoli)	200	2 .3	198	2.3	398	2.3
Total	8899	100 %	8634	100 %	17533	100%

To evaluate the resistance of 13 okra genotypes against aphids, the red spider mite, the whitefly, the serpentine leaf miner and the potato leaf hopper,mean number of each pest was estimated and presented in Table, 4. As shown in Table(4) aphid population on the different okra genotypes ranged between 52.8 individuals on Balady Varity to 9.75 individuals/10 leaves on Str.L9 which harbored the lowest aphid population and found to be significantly superior over all other lines. Mean mite population revealed that Str.L5 had lowest number of mites(7.67 individuals /10 leaves) followed by Cairo Red (8.75), whereas(HM) had highest number of mites (19.17 individuals /10 leaves). Jack and meredith (1983) reported that cotton leaf had significantly fewer spider mites,*Tetranychus urticae (*Koch), than fergo bract, smooth leaf, nectar less, glandless and normalisolines indicating presence of more number of hairs on leaf lamina offered resistance to mite attack in cotton.

The population density of whitefly on different okra lines showed that, Str.L5 harboured the highest number of (12.93 individuals) ,while (HK) had the lowest number of (5.25 individuals /10 leaves) and there is no different significantly superior over all other lines. Also, ,Population of leaf miner on different okra genotypes ranged between 15.83 leaf miner /10 leaves on Str.L6 to 1.75 leaf miner /10 leaves on Str.L2 which recorded the least leaf miner population and no significantly superior over all other line.

Overall mean number of *E. discipiens* population the obtained results revealed that okra Str.L7 recorded lowest population (0.33) individuals followed by Str.L4 With 0.58 individuals /10 leaves ,whereas Str.L2 and Str.L1 harbored considerably high population of leafhopper 1.83 and 1.75 individuals /10 leaves. Mahal *et al.* (1993) reported that the okra varieties, IC-7194, New selection and Punjab Padmini harboured low leafhopper population and low injury index. This resistance could be attributed to the presence of high density of hairs on lower surface of leaf.

Table(4). Mean numbers of *Empoasca discipiens* (Paoli),*Aphis gossypii* (Glover); *Bemisia tabaci* (Genn.),*Tetranychus urticae (*Koch) and *Liromyaza trifolii* on four varity and nine strain of okra per 10 leaves during two summer seasons (2010 and 2011) in Dakahalia governorate.

	Aphis gossypi Glov.*i*		*Tetranychus urticae*		*Bemisia tabaci*		*Liriomyza trifolii*		*The potato leafhopper E. discipiens*	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Roomy	41.83ab ±68.94	42.13ab ±60.54	11.67 ±11.63	10.67 ±10.63	10.00 ±9.75	9.80 ±7.48	6.83 ±9.90	6.23 ±8.81	1.67 ±2.19	1.66 ±2.20
Balady	52.08a ±61.89	51.08a ±51.88	12.08 ±11.33	11.17 ±10.12	9.17 ±6.58	9.11 ±5. 81	7.83 ±15.35	6.13 ±14.35	1.5 8 ±1.16	1.5 4 ±1.12
HM	34.42abc ±26.31	32.12abc ±27.20	19.17 ±17.38	16.20 ±15.23	10.00 ±7.85	10.22 ±8.00	6.42 ±15.96	6.92 ±13.23	1.42 ±1.24	1.39 ±1.26
HK	28.33abc ±27.50	27.33abc ±25.420	8.75 ±8.51	7.64 ±7.41	5.25 ±4.11	4.86 ±4.60	11.17 ±24.98	9.20 ±21.48	1.58 ±1.51	1.51 ±1.41
Str.L1	26.67 b ±20.27	25.67 b ±21.19	12.50 ±13.61	12.51 ±12.42	7.50 ±7.38	7.20 ±7.21	1.92 ±3.02	1.80 ±3.22	1.75 ±2.38	1.60 ±2.30
Str.L2	23.00bc ±21.04	21.00bc ±22.15	17.42 ±18.69	16.34 ±18.69	9.50 ±11.26	8.50 ±10.22	1.75 ±3.81	1.45 ±3.21	1.83 ±1.99	1.82 ±1.85
Str.L3	20.00bc ±16.90	20.12bc ±13.82	17.42 ±18.69	15.52 ±17.69	6.17 ±5.39	6.00 ±4.99	12.58 ±23.78	11.65 ±21.72	1.42 ±1.83	1.42 ±1.70
Str.L4	16.58bc ±7.37	15.58bc ±6.41	10.67 ±12.69	10.86 ±10.56	6.75 ±6.31	6.50 ±5.92	6.17 ±13.34	6.11 ±13.00	0.58 ±0.67	0.58 ±0.55
Str.L5	15.75bc ±13.33	14.79bc ±13.21	7.67 ±19.36	7.45 ±17.24	12.93 ±15.60	12.83 ±15.60	15.83 ±22.02	15.22 ±21.90	0.83 ±0.72	0.79 ±0.68
Str.L6	16.92 bc ±12.67	16.50 bc ±13.67	14.50 ±29.27	13.50 ±28.21	8.83 ±10.32	8.83 ±10.32	15.33 ±24.07	15.94 ±24.10	1.67 ±2.10	1.62 ±2.22
Str.L7	21.08 bc ±23.11	20.23 bc ±21.91	14.00 ±23.82	13.00 ±21.25	8.67 ±10.17	8.67 ±10.17	11.33 ±19.86	10.13 ±19.06	0.33 ±0.49	0.32 ±0.41
Str.L8	18.00 bc ±11.28	17.00 bc ±10.30	14.83 ±29.33	13.83 ±25.12	6.00 ±7.30	5.56 ±7.41	12.50 ±16.82	12.10 ±16.32	0.83 ±0.72	0.80 a ±0.93
Str.L9	9.75 bc ±6.34	10.70 bc ±4.34	13.00 ±25.88	12.00 ±24.38	12.92 ±13.72	12.90 ±12.44	1.92 ±3.27	1.81 ±2.13	1.25 ±2.38	1.20 ±2.33
LSD 0.05	24.78	23.81	15.8N.S	14.6N.S	22.00N.S	21.22N.S	14.26N.S	13.10N.S	1.30N.S	1.25N.S

The relation between some morphological characters (number of hairs on leaf lamina, number of hairs on midrib and thickness of the midrib) was estimated and summarized in Table, 5..

Number of hairs on leaf lamina.

It was evident from Table (5) that number of hairs on leaf lamina/cm2 was more in variety Str.L9 (18.17 hairs/cm2) followed by Str.L8 (15.16 hairs/cm2). The lowest density was recorded for the strain Str.L5 with 10.01.Values of correlation coefficient between leafhopper population and number of hairs on leaf lamina was significantly negative at 1 % level (r= -0.988**). Similar results were observed between number of hairs on leaf lamina and population of aphids (r= -0.909**) .

Table(5): Morphological characters of some okra genotypes and their correlation with the pest populations(aphid, spider mite, whitefly, leafminer and leafhopper).

Tested okra genotypes	Mean hair density/cm^2		Thickness of the midrib (mm)
	Leaf lamina	Midrib	
Roomy	10.84	11.13	1.41
Balady	10.25	10.91	0.98
HM	10.13	10.11	1.49
HK	10.11	10.61	1.30
Str.L1	10.20.	10.31	1.43
Str.L2	10.31	10.51	1.09
Str.L3	10.16	11.01	1.39
Str.L4	10.84	11.13	1.41
Str.L5	10.01	10.61	1.29
Str.L6	11.66	12.73	1.48
Str.L7	10.09	10.14	1.39
Str.L8	15.16	16.11	1.01
Str.L9	18.17	19.14	.21١.
Correlation coefficient for			
Aphids	r -0.909**	-0.938**	+0.847*.
	R2 0.82	0.89	0.72
Red spider mite	0.983** + r	0.968**	+0.858**
	R2 0.94	0.97	0.74
Whitefly	r +0.944**	+0.967**	-0.801*.
	R2 0.89	0.94	0.64
Serpentine leaf miner	r -0.905**	-0.928**	-0.838*
	R2 0.85	0.80	0.75
Leafhopper	0.988** - r	-0.985**	-0.938**
	R2 0.97	0.98	0.88

**** - Significant at 1% level * - Significant at 5% le**

Roomy(R),Balady(B),Mansoura Red(HM),and Cairo Red(HK).

On the contrary, there was a significantly positive correlation between the number of hairs and both whitefly (r= +0.944**) and mites (r=+0.983**) populations. Hairiness of the leaves influences the leafhopper population to the extent of 97 per cent and aphids, leaf miner, whiteflies and mite populations to the extent of 82,85.,89 and 94 per cent, respectively. Khan *et al.* (2000) reported that trichome density exhibited a significant negative influence on the number of aphids (*Aphis gossypii*). Bindra and Mahal (1979) screened the influence of leaf area and hair density on lamina side vein and mid rib for ten okra varieties on leafhopper population. Leafhopper population was found to decrease only with the increase in lamina. According to Khan *et al.*, (2000) aphid numbers were lowest on the terminal and young leaves compared with matured leaves. Trichome density was found to have a significantly negative influence on the number of aphids. As age of the plant increase, increase in the size of leaf lamina, decreases the hair density and increases the population of aphid.

Number of hairs on leaf midrib.

Maximum number of hairs on midrib was recorded in variety Str.L9 (19.14hairs/cm^2) and also in Str.L8 (16.11 hairs/cm^2). The lowest hair number was recorded for HM with (10.11 hairs/cm2) .The correlation between pest population and mid-vein hair density was significantly negative for leafhopper (r= -0.985**), aphids (r= -0.938**) and leaf miner(-0.928**)and thus it appears to be an important factor in imparting biophysical resistance in okra against these pests. Whereas, significantly positive correlation was observed between mid-vein hair density and population of whitefly (r= +0.967**) and mites (r= +0.968**), favoring the whitefly population buildup.Influence of mid-vein hair density on different sucking pests population *i.e.* ,leafhoppers, aphids, leaf miner, whiteflies and mites was to the extent of 98, 89,80, 94 and 97 per cent respectively. According to Jack and Meredith (1983) reported that presence of more hairs on leaf lamina offered resistance to mite attack.

Thickness of the midrib

The data in Table :(5) shows that the thickness of the midrib (mm) was consistently high in leaves of Mansoura Red (HM), Str.L6 and Roomy (1.49, 1.48 and 1.41 mm), while, thickness was consistently low in Balady and Str.L8 (0.99 and 1.01 mm). The correlation coefficient between thickness of the mid-vein and population of leafhoppers, showed a significantly positive correlation (r= +0.938**). Similar trend was observed between midrib thickness and population of aphids (r= +0.847**) and mites (r= +0.858**). While a significantly negative correlation was observed between midrib thickness and population of whitefly (r= -0.801*)and leaf miner(r= - 0.838*). Overall impact of midrib thickness on the population of sucking pests i.e.., leafhoppers, aphids, leaf miner, whiteflies and mites was to the extent of 88, 72,75, 64 and 74 per cent ,respectively .

According to Rao et.al. (2003) 72 species of insects have been recorded on okra (Srinivas, of which, the sucking pests comprising of Aphids (*Aphis gossypii* Glover), leafhopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius) and mite (*Tetranychus cinnabarinus* Boisduval) causes significant damage to the crop. Thickness of the midrib was significantly positive correlated with leafhopper, aphid and mite populations, which indicated that as midrib thickness increases the population buildup of these sucking pests. These results are in conformation with the findings of Raghumoorthi and Kumar (2000), Yadava *et al.* (1967), Ambekar and Kalbhor(1981) and Sahu and Rayachaudhari (1995). There was a significantly negative correlation between thickness of the midrib and population of whitefly on different varieties indicating increase in thickness of the midrib decreases the whitefly population. The present investigation is in contrary with the earlier reports, where Murtaza *et al.* (1999) reported that, midrib thickness in cotton varieties was significantly positive correlated with whitefly population. However, no such earlier studies on okra crop, the morphology of plant varies from one crop to another and pest preference also changes with the change in plant species. This may be the reason for variations in the results. However, from the present study on interactions of okra genotypes against some sucking pests, it can be concluded that the genotypes Balady(B),Mansoura Red (HM), are susceptible for (aphids, mites, whitefly, leaf miner and leafhopper, respectively). While genotypes Romy (R), Str.L1, Str.L3, Str.L4, Str.L6 and Str.L8 were cosidered as moderate. In the mean time, Str.L9, Str.L5, Cairo Red (HK),Str.L6 and Str.L7, are resistant against (aphids, mites, whitefly, leaf miner and leafhopper, respectively) and can be recommended for cultivation in areas where high incidence of these pests are noticed.

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حساسية ١٣تركيبا وراثيا من الباميا للإصابة ببعض الآفات وارتباط ذلك بمورفولوجيا الأوراق

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أجريت هذه الدراسة بغرض تحديد الفروق بين أربع أصناف و٩ سلالات تمثل ثلاثة عشر تركيبا وراثيا من الباميا مستنبطة في دراسة سابقة بطريقة سجلات النسب من حيث الإستجابة للإصابة ببعض الآفات(المن ، نافقات الأوراق ، الذبابة البيضاء ، الأكاروس و نطاطات الأوراق) . وقد تم ذلك من خلال إجراء تجربة ميدانية في صيف عامين متتاليين ٢٠١٠ و ٢٠١١ في مزرعة محطة بحوث البرامون التابعة لمعهد بحوث البساتين بالمنصورة. وقد أوضحت الدراسة وجود المن على التراكيب الوراثية تحت الدراسة بأعلى نسبة خلال موسمي الدراسة في حين سجلت النطاطات أقل نسبة تواجد. كما أظهرت الدراسة ارتباطا معنويا موجبا بين عدد الشعيرات على الورقة وحجم عشيرة الذبابة البيضاء (R = ٠.٩٤٤ **) الاكاروس(R = +٠.٩٨٣ **). ،كما وجد أن كثرة الشعر علي الأوراق يؤثر على تعداد المن،صانعات الأنفاق ، الذبابة البيضاء الاكاروس و الجاسيد حيث وصل التعداد إلى حد ٨٢،٨٥، ٨٩ و ٩٤و ٩٧ في المائة على التوالي . والعلاقة الإرتباطية بين تعداد الآفات و كثافة الشعر في العرق الوسطى كانت معنوية وسلبية في الجاسيد (R = -٠.٩٨٨ **)، المن (R = -٠.٩٣٨ **) نافقات الأوراق (R = ٠.٩٢٨ **) ، وبالتالي فأن هذة الصفات تعتبر هامة في المقاومة البيوفيزيائية لهذه الآفات في الباميا. فقد لوحظ ارتباط إيجابي ذو دلالة إحصائية بين كثافة الشعر علي العرق الوسطي لصالح تعداد الذبابة البيضاء و الاكاروس((R = ٠.٩٦٧ **وR =**٠.٩٦٨). وكان تأثير كثافة الشعر علي العرق الوسطي على تعداد نافقات الأوراق، المن ، الذبابة البيضاء ، الاكاروس و الجاسيد بلغ ٨٠، ٩٤، ٨٩، ٩٧ و٩٨ %، في حين كان تأثير سمك الضلع الأوسط للورقة على تعداد الجاسيد ، المن، نافقات الأوراق ، الذبابة البيضاء الاكاروس ٨٨، ٦٤، ٧٢،٧٥ و ٧٤ % على التوالي. وبالتالى يمكن تصنيف التراكيب الوراثية الثلاثة عشر إلى ما يلي: ١-تراكيب وراثية حساسة للإصابة بالآفات الخمسة على النحو التالى: الصنف بلدي والصنف أحمر منصورة، ٢- تراكيب وراثية متوسطة الإصابة ويمثلها:الصنف رومي وكل من السلالات ١ و٣ و٤ و٦ و ٨ و ٣- تراكيب وراثية مقاومة وهذه يمثلها: السلالة ٩ و٥ والصنف أحمر قاهرة والسلالة ٢ والسلالة ٧. ويذلك توصى الدراسة بإمكانية الاستعانة بزيادة زراعة تلك التراكيب الوراثية المقاومة في البيئات التي تنتشر بها تلك الأفات.

قام بتحكيم البحث

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