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DETERMINING RELATIONSHIPS BETWEEN MORPHOLOGICAL, SOME ANATOMICAL TRAITS AND PHENOLES REALATED TO INSECT RESISTANCE IN TWO CROSSES COTTON

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ABSTRACT

This invstigation aimed to study the importance of morphological and anatomical traits with total phenols in leaves and bolls for insect resistance and evaluate the hybrids of Giza 88 okra leaf shaped and cultivar Giza 88 with promising cross [{G.84 x(G.70 xG.51B) x pima 62 }].The trial was conducted at Sakha Research Station during 2010 and 2011summer seasons. The results indicated that the leaves of line G.88 okra leaf characterized by narrow lobes while Giza 88 was wider lobes. Giza 88 characterized by increase for size of leaf nectaries and No. of bolls nectaries. Total phenols in leaf was high for the parent Giza 88 okra leaf, while F1 was intermediate between its two parents. The anatomical study revealed narrow difference between anatomy structural of the two parents Giza 88 and line Giza 88 okra for leaves. Anatomical features were observed, firstly the extension of the palisade tissue towards the mid vein of two parents exhibited palisade tissue, secondly the presence one in G.88 okra while G.88 had two small reverse oriented bundles separated. The F1 had not small reverse oriented bundles. The results of principal components exhibited that the two factors I and II were more importance about 87.45% of total variance, while the two factors III and IV were less importance about 21.11% of total variance .Factor I accounted for 40.32% of total variance including lobbing index , spongy tissue thickness, mid vein thickness, width of main vascular bundle and No. of xylem rows had positive loading indicates the direction of relationship between factor and variables .Factor II accounted for 38.13% including laminar thickness, spongy tissue thickness , width of main vascular bundle, No. of xylem vessels in row and total phenols of leaves and bolls, the results of anatomical traits play considerable role for resistance with that total phenols. It could be concluded that traits of laminar thickness, spongy tissue thickness, width of main vascular bundle and No. of xylem vessels in row have interrelation ship with total phenols of leaves and bolls that these traits play the main role in insect resistance. It could be concluded that traits of laminar thickness, spongy tissue, width of main vascular bundle and No. of xylem vessels in row have interrelationship to total phenols as indication for insect resistance in positive direction, no differences were noted between the structural anatomy of the two parents Giza 88 and line Giza 88 okra leaf for leaves, but the leaves of line G.88 okra varied morphologically by narrow lobes.

Keywords: Cotton, morphological, yield, Fiber Quality, leaves anatomical characters, total phenols and principle components analysis

INTRODUCTION

Genetic divergence among parents is considered an important factor to create variability by hybridization for selection superior lines. Therefore; they require information to identify the traits which relate to insect resistance for breeding program. The need of breeding programs insect resistance for is more important to decrease production costs. Many investigators reported that okra leaf shape and total phenols were considered traits related to pest resistance. The phenolics may have chemical defense against various insect Wilson and George (1982) EL-Zik and Thaxton (1989) reported that the resistance to insect was associated with several plant morphological traits such as okra leaf, frego bract, nectariless, dense hair, glabrus and red plant colour. Mohamed *et al* (2005) studied some Egyptian okra leaf they found that okra leaf shape tended to significant increase in leaves content of phenols and some chemicals content. This increase was associated with the resistance to insects such as jasside, whitefly and cotton leave warm. Ali (2006) reported that reduction rate on number of pink bollworm ranged from 71.44% for (G.88 X Okra leaf) to 81.69 % for (G.90 X Hairy leaf). Max (2004) found that multivariate techniques principle components revealed leaf area and leaf shape index were important components among the studied traits related to insect resistance in cotton , also they found second Pc axis separated two lines nectariless - Okra leaf from both Giza 83 and Giza 85 parents and their F_1s. Sultan (2008) found that correlation coefficient between the infestation percentage with morphological traits such as (lobbing index) and some anatomical traits, also, reported that principle components analysis was conducted on eight traits related to insect resistance and some anatomical traits in four axis, which together were responsible of 72.6% of total variability of all characters. The first three axis were equal important its account for 58%, while the forth axis was less importance account for 14.7%.

The present study aimed to determine the inercorrelation between morphological and leaves anatomical characters with total phenols contents in leaves and bolls to clear the importance of these traits in the insect resistance for pink bollworm , as well as to evaluate and comparing the Egyptian strain Giza 88 okra leaf shaped with the check cultivar Giza 88

MATERIALS AND METHODES

Two extra long- staple Egyptian cotton cultivars of *Gossypium barbadense* Giza 88 and promising cross [{G.84 x(G.70 xG.51B) x pima 62}] as well as the insect resistant line Giza 88 okra leaf shape which was produced from discontinuous backcrossed to the cultivar Giza 88 X Line MAR GN-8 *G. hirsutum*.L. were used as parents to produce two hybrids as follow:

1- [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88 okra leaf

2- [{G.84 x (G.70 xG.51B) x Pima 62} X Giza 88.

The hybridization were made 2010 season at sakha Agricultural Research Station, in next

season F1 plants and three parents were grown as individual plants.The rows were 4 meters long and 60 cm apart and 20 cm between hills. Standard culture method was applied through the growing season. Data of the parents and F1 population were recorded on individual guarded plants using Randomized Complete Block Design for the following characters:

1. Morphological characters

All leaf parameters as on average of five plants randomly were selected for fifth leaf per plant were measured at age of 75 days

- Lobing index: the ratio between; length of middle lobe cm / leaf length cm^2

-Size of leaf nectaries (The measurement with mm and transformed to its Log)

-Number of nectaries / boll; average of five bolls, No. of nectarias in cm2

2. Yield components and fiber properties

The measurements were recorded on ten individual guarded plants for the three parents and 30 plants for two hybrids F1

Seed cotton yield per plant in grams-

Lint yield per plant in grams -

Lint percentage; was obtained from the formula: L% = lint yield / seed yield x 100-

-Fiber length; upper half means/ mm

- Fiber strength; Presley index

-Fiber fineness; micronaire reading

3. Estimation of total phenols

The determinations were done in leaves and bolls. The leaves samples were taken from the upper fourth leaf from the apex at the age of 75 days.The bolls samples were taken at the two weeks after flowering. Total phenols were determined according to (Simons and Ross, 1971).

4. Anatomical study

Transverse sections was made of the median leaf (blade) of the main stem, samples were taken at the age of 75 days for three parents and the two hybrids F1,measurements and counts some anatomical traits , means of five reading from two slides were calculated .

Statistical analysis

The data for all traits were estimated as the means and its standard error. The morphological and anatomical traits with total phenols in leaves and bolls were analysis as principal components statistically by using (SPSS) software.

RESULTS AND DISCUSSION

Morphological traits

The mean performance of three morphological traits of three parental genotypes and F1 of two crosses are presented in Table (1). The data showed that the parent Giza 88 okra leaf exhibited highest value surpassed the other two parents as well as the two values of F1 for lobbing index.

The data of the cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88 okra leaf] in Table (1) showed that its two parents differed with significant difference. The highest value of lobbing (95.33) was recorded for parent G.88 okra leaf, while low value of lobbing index (75.96) was recorded the promising cross [{G.84 x (G.70 xG.51B) x Pima 62. The data of its F1 was intermediate between parents.

The data of second cross [{G.84 x (G.70 xG.51B) x Pima 62}] X Giza 88 exhibited the values of parents [{G.84 x (G.70 xG.51B) x Pima 62}] and

Giza 88 were recorded (75.96) and (74.90), respectively for lobbing index, and its F1 exhibited same trend of these parents.

These results suggested that the trait of lobbing index did not exhibited hybrid vigor. These results were in harmony with those obtained by Chaudaèr*i et al* (1990), Thaxtone *et al* (1998) and Sultan (2008).

With respect to the trait size of leaf nectaries, the data in Table (1) showed that performance

of the first cross [{G.84 x(G.70 xG.51B) x pima 62] X Giza 88 okra leaf] ,the parents {G.84 x (G.70 xG.51B) x pima 62 and G. 88 okra leaf exhibited the values (1.86 and 1.76), respectively while F1 [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88 okra leaf] exhibited value (1.78) . These results indicated that the value of F1 was intermediate between two parents while nearest to the parent which exhibited small size nectaries.

While the second cross [{G.84 x (G.70 xG.51B) x Pima 62}] X Giza 88], the results exhibited parent [{G.84 x (G.70 xG.51B) x Pima 62}] and Giza 88 recorded (1.86 and 1.84), respectively for size of leaf nectaries, while it's F1 recorded (1.82) which was intermediate between its parents .The results of the two crosses suggesting absence dominance or partially dominance indicating to existence of additive gene action for this traits. These results are in agreement with those obtained by Choudheri et al (1990), Thaxtone *et al* (1998) and Sultan (2008). With regard to the number of bolls nectaries, the data in Table (1) showed that the parents of the first cross [{G.84 x (G.70 xG.51B) x pima 62} X Giza 88 okra leaf] were recorded the values (74.82 and 51.4), respectively for P1 and P2 .While the F1 exhibited the value (62.0) which was intermediate between the parents suggesting the absence of dominance. For the second cross [{G.84 x (G.70 xG.51B) x Pima 62}] X Giza 88] the results in Table (1) showed that the two parents exhibited the values (74.82 and 75.0), respectively for P1 and P3, While the F1 exhibited the value (49.8) for No. of bolls nectaries.

Total Phenols

Many investigators indicate that the total phenol of leave was indicator to insect resistance, Perveen *et al* (2001). Table (1) showed the values of total phenols of leaves and bolls for two crosses.

The parents of the first cross [{G.84 x (G.70 xG.51B) x Pima 62] and Giza 88 okra leaf exhibited (116.4 and 118.4 PPm), respectively, while the value of F1 was (115.75 PPm). These results suggested that the two parents were more resistance than F1. For total phenols of bolls, the two parents and its F1 exhibited same trend.

With regard to the results of the second cross the values of the two parents [{G.84 x (G.70 xG.51B) x Pima 62] and Giza 88 as well as F1 were 116.4, 112.0 and 116.45 PPm, respectively .These results showed that the P1 and F1 exhibited same trend.

For total phenol of bolls, the two parents and F1 exhibited the values of (108.25, 107.35 and 108.65 PPm), respectively. These results without tany difference s.

These results were in harmony with those obtained by Bashan .Y (1986) and Daniel *et al* (1992).

Yield and its components and fiber quality

Table (2) showed the mean performance of yield components and fiber traits for the two crosses and its parents. With regard to the first cross (P1 xP2) the data indicated that the performance of the two parents as well as its F1 for seed and lint cotton yield were not differ significantly, while lint percentage of the parent [{G.84 x (G.70 xG.51B) x Pima 62] exhibited higher value of lint percentage than the second parent G.88 okra leaf with significant differences. The F1 of first cross exhibited value of 37.50 % for lint percentage which did not differ from the first parent indicating no existence for the dominance effect.

With regard to the second cross the mean performance of seed cotton yield, the two parents [{G.84 x (G.70 xG.51B) x Pima 62] and G.88 exhibited the values 99.67 and 87.38 gm /plant, respectively with significantly difference. The second F1 exhibited high value of 129.60 for seed cotton yield which is higher than both parents indicating the existence of over dominance.

For lint yield the two parents of the second cross exhibited values of 38.24 and 34.863, respectively with significant differences. While the second F1 exhibited higher value of 51.01 lint yield exhibiting hybrid vigor. for

For lint percentage the parents of second cross exhibited values of 38.40 and 38.79 with insignificant differences, while the F1 exhibited value 39.23 of lint percentage without any significant differences.

With regard to the fiber traits, Table (2) showed mean performance of the fiber traits.The data in Table (2) indicated that there were not differences between the three parents and its two $F1_{s,}$ for fiber length and uniformity ratio. For micronaire value, the data indicated that the two parents of the first cross [{G.84 x (G.70 xG.51B) x Pima 62] and G.88 okra leaf exhibited 4.21 and 3.84, while its F1 exhibited the value of 4.09.

For pressly the mean performance values of 11.0, 10.58 and 11.08 for [{G.84 x (G.70 xG.51B) x Pima 62], G.88 okra leaf and F1, respectively.

With regard to the second cross the data in Table (2) showed that mean performance for micronaire value were 4.21, 4.32 and 4.26 for P1, P3 and F1, respectively. While the mean performance of pressly were 11.0, 11.20 and 11.31 for P1, P3 and F1, respectively.

Anatomical study:

Anatomy of leaf:

Table (3) represents the measurements which were taken from mature leaf transactions of all studied parents and two crosses at age of 75 days. Table (3) and (Fig.1 a, b, c) showed that the parent [{G.84 x (G.70 xG.51B) x Pima 62] recorded the maximum value of upper and lower epidermis thickness, (23.32and 17.80), while the parent G.88 okra leaf recorded values (20.20 and 14.34) of upper and lower epidermis thickness, respectively. The data of its F1 exhibited values (18.51and 17.32) for upper and lower epidermis the same of this parent [{G.84 x (G.70 xG.51B) x Pima 62] for lower epidermis thickness.

For the second cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88] the results in Table (3) and (Fig.2 a, b, c) exhibited that the parents [{G.84 x (G.70 x .51B) x Pima 62} recorded (23.32 and 17.80) and Giza 88 recorded (18.25

and 19.82) for upper and lower epidermis thickness, respectively. While its F1 recorded (22.50 and 17.010 for upper and lower epidermis thickness), respectively.

Regarding laminar thickness, of the first cross the data in Table (3) and (Fig.1 a ,b ,c)] revealed that the parent [{G.84 x (G.70 x .51B) x Pima 62}recorded the highest value (303.09 u) for laminar thickness while the parent Giza 88 okra leaf recorded (299.41u) and its F1 cross recorded higher laminar thickness (305.55 u) with comparing the two parents. The second cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88] of the results exhibited that the two parents [{G.84 x (G.70 x .51B) x Pima 62} and Giza 88 as well as F1 were (303.09, 265.65 and 320.91 u) for laminar thickness respectively. These results were in harmony with those obtained by Sultan (2008) reported that Egyptian cultivars recorded relatively thicker blades compare to the upland lines.

With regard to the palisade tissue thickness, the data in Table (3) and (Fig.1 a,b,c) showed that the parents of the first cross (P1x P2) had thicker palisade tissue with ratio approximately 2/3 the laminar thickness(146 / 303and 11 7 / 299) for P 1 and P2, respectively Fig.1 ,while its F1 plants recorded (131/325) for palisade tissue with same trend . With respect to the second cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88] its two parents and F1 exhibited the same trend ratio approximately 2/3 the laminar thickness (146/303, 116 /265 and 129/320), respectively. These results are in harmony with those obtained by Sultan (2008) who reported that the parent Giza 88 had palisade tissue ratio approximately 2/3 the laminar thickness.

For spongy tissue thickness of the first cross (P1xP2), the two parents and its F1 exhibited the values of (113.27, 138.86 and 152.69 u), respectively. These results indicated that the F1 was surpassing the corresponding parents Fig.1 .

While the parents of the second cross {G.84 x (G.70 x .51B) x Pima 62}, Giza 88 and F1 recorded (113.27, 109.56 and 136.49 u), respectively for spongy tissue thickness (Fig .2 a,b,c) .

With respect to mid vein thickness of the first cross (P1xP2) the data in Table (3) and (Fig .2 a,b,c) showed that the parents and its F 1 recorded (1238.83, 1392.99 and 1345.14u), respectively. These results indicated that the F1 was nearest the parent G.88 okra. While in the second cross (P1xP3) the results exhibited that the parents P1 and P3 recorded (1238.83 and 1390.93u), respectively, while its F1 recorded (1412.32u) ,this value surpassed corresponding the parents.

Concerning the length and width of main vascular bundle, the first cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88 okra leaf] recorded the values (469.22and 745.94u), (472.33 and 948.40 u) and (503.97 and 869.28 u), respectively for P1, P2 and F1 for length and width of main vascular bundle, respectively. For the second cross [{G.84 x (G.70 x .51B) x Pima 62} X Giza 88] the results in Table (3) and Fig.2 showed that the two parents exhibited (469.22 and 745.94 u) and (539.89 and 997.39 u) for length and width of main vascular bundle, respectively, while the F1 exhibited (578.43 and 895.40 u) for length and width of main vascular bundle. These results indicated that the parent G.88 exhibited the longest and widest of the main vascular bundle.

For No. of xylem rows the results of the first cross (P1xP2) for the two parents and F1 were recorded the values (23, 29 and 31), respectively. These results of its F1 were intermediate between parents. The second cross (P1x P3) exhibited that the values of the two parents and F1 were recorded (23, 31 and 28), respectively for No. of xylem rows.

Anatomical features were observed firstly, the extension of the palisade tissue towards the mid vein of the three parents (Fig.1 and 2) , secondly ,the presence one or two small reverse oriented bundles separated from the main largest one were noted in Giza 88 and Giza 88 okra leaf , reverse oriented bundles were noted in F1 crosses.

It could be concluded that no differences were noted between the structural anatomy of the two parents Giza 88 and line Giza 88 okra leaf for leaves, but the leaves of line G.88 okra varied morphologically by narrow lobes.

Principal components analysis

Principal components analysis was conducted on 15 traits including morphological and leave anatomical traits as well as total phenols of leaves and bolls as indication to insect resistance .The data were showed in Table (4) .The data indicated that the first four principal components axes accounted 100% of total variance of all traits. The joint value and their contribution toward the total variation associated with first four axes in Table (5). Principal components showed that the first principal component axis accounted for about 40.32% of multivariate variation among genotypes .Also the data indicated that the second axis accounted for about 38.13%. These results suggesting that the first two axes were more important and they accounted for about 78.45%. While the third and fourth axes were less importance and they account for about 12.73 % and 9.38%, respectively. In this respect

Gutierrez *et. al.* (1988) reported that the first three principal components accounted for 54% of the total variability among twenty *G. hirsutum*, cultivars for 16 studied traits. Brown (1991) studied PCA, of cotton cultivars based on 17 agronomic and fiber characters and they reported that the first three PCA accounted for no less than 62 % of total variance. Table (4) showed that the first two axes were of equal importance and account 78.45%, while the other two axes were less importance and account about 21.55% of total variance. In this respect El –Feki et al (2009) reported that the first three axes were of equal importance and account for about 58%, while fourth axis was of less importance account for 14.7%. Table (5) showed the summary of factor loading for 15 traits of cotton genotypes of relative magnitude of eigen coefficient of each character was become of considerable important when its greater than 0.5. The data in Table (5) indicated that the factor (I) include lobbing index, spongy tissue, mid vein thickness, width of main vascular bundle and No. of xylem rows had positive loading indicates the direction of relationship between factor and variables.

While the negative direction of relationship were expected by size of leaf nectaris , No. of boll nectaries, upper epidermis thickness, and palisade tissue .Factor II include laminar thickness, spongy tissue, width of main vascular bundle, No. of xylem vessels in row and total phenols of leaves and bolls, these results suggested that anatomical traits play role for resistance with considerable that total phenols were indication to insect resistance in positive direction, while the variables size of leaf nectaries , No. of boll nectarines and lower epidermis thickness exhibited negative direction of loading . Factor III include that variables of upper epidermis thickness and length of main vascular bundle upper epidermis thickness, loading while negative was exhibited by No. of xylem vessels in row. Factor IV include the variable of lower epidermis thickness by positive direction of loading.

It could be concluded that traits of laminar thickness, spongy tissue, width of main vascular bundle and No. of xylem vessels in row have interrelationship to total phenols as indication for insect resistance in positive direction.

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تحديد العلاقة بين بعض الصفات المورفولوجية و التشريحية والفينولات وعلاقتها بالمقاومة للحشرات فى هجينين من القطن

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معهد بحوث القطن – مركز البحوث الزراعية -جيزة

يهدف هذا البحث الى دراسة العلاقة بين الصفات المورفولوجية والتشريحية للورقة مع نسبة الفينولات الكلية فى ا لورقة واللوزة وعلاقتها بالمقاومة للحشرات وكذلك مقارنة الصنف جيزة ٨٨ مع السلالة المقاومة جيزة ٨٨ okra leaf . وقد أستخدم فى هذة الدراسة صنفين من القطن التابع لمجموعة الاقطان فائقة الطول { [جـ ٨٤ ×(جـ٧٠× جـ ٥١ب)]×بيما س٦ } وجيزة ٨٨ بالاضافة الى السلالة المقاومة للحشرات (جيزة ٨٨ okra leaf) وفد تم التهجين بين الاباء لانتاج هجينين من القطن واجريت التجربة بمحطة البحوث الزراعية بسخا خلال موسمين ٢٠١٠، ٢٠١١.

وكانت أهم النتائج فيما يلى :

١ – اظهرت النتائج ان اختلافات معنوية بين الصنف جيزة٨٨ و السلالة المقاومة جيزة ٨٨ okra leaf مورفولوجيا من حيث عمق التفصيص ،حجم الغدة الورقية وعدد الغد د فى اللوزة وكان الجيل الاول وسط بين الابوين ، ارتفاع نسبة الفينولات الكلية فى الورقة للسلالة المقاومة جيزة ٨٨ okra leaf ولم يختلفان فى اللوزة .

٢ – أوضحت دراسة التركيب التشريحى للورقة تشابها بين الصنف جيزة٨٨ و السلالة المقاومة جيزة ٨٨ okra leaf من حيث أمتداد النسيج العمادى تحت البشرة العليا للنصل ، و وجود حزمة وعائية منفصلة فى جيزة ٨٨ okra ، أوحزمتين وعائيتين معكوستى الوضع تقعان ناحية السطح العلوى للورقة فى الصنف جيزة٨٨ وغير موجودة فى الجيل الاول للهجينين .

٣– أظهرت النتائج ان السلالة جيزة ٨٨ okra زيادة فى سمك طبقة الابيدرمس العليا ، سمك طبقة النسيج الاسفنجى مقارنة بجيزة ٨٨ .

٤– أظهر التحليل العاملى على ١٥ صفة لها علاقة بالمقاومة للحشرات فى اربعة محاور ، ان العامل الاول والثانى هما الاكثر أهمية ويمثل ٧٨,٤٥% من التبا ين الكلى بينما المحور الثالث و الرابع يمثل ٢١,٥٥% من التباين الكلى .

٥– اوضحت النتائج ان المحور الاول اشتمل على الصفات الاتية : معامل التفصيص – حجم الغدة الورقية– عدد الغدد فى اللوزة–سمك البشرةالعليا– النسيج العمادى والاسفنجى – سمك العرق الوسطى– عرض الحزمة الوعانية –عدد صفوف الخشب ويمثل ٤٠,٣٢% من التباين الكلى.

-٦ أشتمل المحور الثانى على الصفات الاتية: حجم االغدة الورقية– عدد الغدد فى اللوزة – سمك النصل– النسيج الاسفنجى– عرض الحزمة الوعائية– عدد صفوف اوعيةالخشب فى الحزمة الواحدة – نسبة الفينولات فى الورقة واللوزة ويمثل ٣٨,١٣% من التباين الكلى .
٧- اوضحت النتائج ان المحور الثالث اشتمل على صفات سمك البشرةالعليا – طول الحزمةالوعائية – عدد صفوف اوعيةالخشب فى الحزمة
الواحدة ويمثل ١٢,١٧% من التباين الكلى والمحور الرابع يعتبر اقل أهمية ويمثل ٩,٣٨ % من التباين الكلى ويشمل سمك البشرة السفلى.

نستخلص من النتائج السابقة انة توجد علاقة موجبة بين نسبة الفينولات الكلية كمؤشر لوجود المقاومة للحشرات وبين بعض الصفات التشر يحية للورقة كسمك النصل – وسمك النسيج الاسفنجى– عرض الحزمة الوعائية– عدد صفوف اوعية الخشب في الحزمة الواحدة ، مما نستخلص منة ان هذة الصفات تلعب دورا هاما في المقاومة للحشرات .

قام بتحكيم البحث

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