EFFECT OF CERTAIN CHEMICAL COMPONENTS AND SOURCE OF RICE PLANT ON ITS RESISTANCE TO RICE STEM BORER, *CHILO AGAMEMNON* BLES. AND RICE LEAF MINER, *HYDRELLIA PROSTERNALIS*, DEEM .

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Abstract

Different rice entries, of known sources, were planted. Rice Stem Borer (RSB) and Rice Leaf Miner (RLM) infestation was evaluated. Total protein, crude silica and fifteen amino acid contents were determined. The correlation between chemical contents and insect infestation showed certain results.

Protein increased RSB infestation in most rice entries with positive correlation (r=0.45), while decreased RLM infestation in most rice entries with negative correlation (r=-0.77). Silica decreased infestation of both RSB and RLM and RLM with negative correlations (r= -0.13 and -0.23, respectively). Free amino acids showed different effects. Some of them decreased RSB infestation as alanine, glycine, histidine + arginine, aspartic+serine and valine, and some decreased RLM infestation as ornithine + lysine, histidine + arginine and methionine. Other amino acids increased insect infestation.

Japonica entries showed more resistance against RSB than indica entries and have less protein content, while the indica entries showed more resistance againt RLM insect and higher protein content. As so, the source plays role in host resistance .

It can be concluded that chemical components may play an important role in plant resistance, but is not the deterimental factor and other morphological, histological, and/or chemical factors share in plant resistance.

INTRODUCTION

Rice is considered as one of the most important cereal crops in Egypt. The Rice stem borer (RSB), *Chilo agamemnon* Bles. and the rice leaf miner (RLM), *Hydrellia prosternalis* Deem are considered the main insects that cause significant losses in rice crop yearly.

Realizing the side effects of insecticides has caused increased interest in search for new measures of insect control. The use of integrated pest management (IPM) in insect control is the new approach in this respect. Selection of resistant varieties is an important item in IPM field. Chemical resistance strongly shares in varietal resistance and helps in selecting and presenting new resistant varieties in breeding programs.

Little attention has been given to the chemical resistance of the host plant in Egypt. This study is an attempt to correlate the contents of certain chemical components with the resistance of rice entries against RSB and RLM attack to present some chemical components that play a role in rice plant resistance.

MATERIALS AND METHODS

Four field experiments were conducted during 1993 and 1994 at Sakha Station, Kafr El-Sheikh Governorate. Different rice entries were planted for insect and chemical evaluations.

A. Field experiments: Through 1993 season, eleven rice entries, with known sources, were planted (3 rows x 6 m x 34 rep./entry) in two dates i.e. recommended (15 May) and late (15 Jue), for insect and protein content evaluation. Through 1994, nineteen entries were planted in the same dates and design for insect, silica and free amino acids content evaluation.

B. Insect evaluation: Infestation of two major rice insects was evaluated i.e., Rice Stem Borer (RSB) and Rice Leaf Miner (RLM). As for RSB, percentage of dead hearts (60 days after transplanting) as well as white heads (10 days before harvest) and then total damage percentage (dead hearts + white heads) of 25 hills/ replicate were calculated. For RLM insect, percentage of damaged leaf area (DLA %) (as an average of 40 and 60 days after transplanting results) of 50 leaves/rep. was calculated. The average of infestation of each pest at the two sowing dates was calclated.

C. Chemical evaluation : Samples of the hills/rep. were air-dried for three days and put in an oven at $60^{o}C$ for 48hr., finely ground and kept for determining total protein, free amino acids and crude silica contents.

Protein and silica contents were assessed according to Yoshida *et al.* (1976). Free amino acids were extracted acccording to Mengel and Helal (1968), and separated and determined using the paper chromatographic technique of Block et al. (1958). The chromatograms were sprayed with 0.2% ninhydrine in acetone w/v as Smith (1958) and then dried for 15 minutes at $60^{o}C$. The amino acids in the samples were identified according to the R_f values of known amino acids.

Correlation between infestation and chemical contents was done.

RESULTS AND DISCUSSION

A. Protein content, insect infestation and plant source correlation

As for RSB insect, Table 1 showed the relationship between protein content of the rice plant and the percentage of RSB damage as an average of the two sowing date results. Data showed that protein content differed according to the rice entry. It ranged from 17.61% in Giza-176 resistant, entry of 5% infestation to 27.39% in GZ 4255-8-1, susceptible entry of 7.9%. Telle Hamsa entry that had a high protein content (23.32 %) was severely infested (12.0 %), whereas GZ 3486-34-3 entry which had low protein content (18.21 %) was less infested (5.9 %). Statistical analysis showed a positive correlation between protein contents and RSB infestations (r=0.45). Therefore, it appeared that the high protein content in rice plant rendered it more susceptible to RSB infestation. These results are in agreement with Pathak (1967). Some entries which are not in agreement with this rule means that there are other factors which share in plant resistance.

Data summarized in table 2 indicate that entries of japonica source showed more resistance (4.6 %) with lower protein content (20.3%), while those of indica source showed more susceptibility (7.6%) with higher protein content (22%). Similar results have been achieved by Tantawi (1982), Kim *et al.* (1986) and Gu *et al.* (1989). This relation may be attributed to genetic bases.

Concerning RLM insect, table 3 showed the relationship between protein content and percentage of damaged leaf area (DLA %) with RLM insect as an average of the two sowing date results. The statistical analysis showed that there was an insignificant negative correlation between the percentages of damage in different entries and their protein contents (r=-0.076).

Table 1. The relationship between total protein content of different rice entries and damage caused by *C.agamemnon* .

Entry		Infestation	Nitrogen	Protein
Name	Source	%	%	%
Todorokiwase	Japonica	2.6	3.46	20.59
Giza 159*	Japonica	3.4	3.83	22.79
Kagahikari	Japonica	3.6	3.09	18.39
GZ 4255-6-4	Ind.X Jap.	3.9	3.46	20.59
Giza 176*	Japonica	5.0	2.96	17.61
GZ 4386-34-3	Japonica	5.9	3.06	18.21
GZ 4565-S-10	Ind.X Jap.	6.0	3.53	21.00
IR 40*	Indica	6.3	3.09	18.39
Giza 171*	Ind.X Jap.	7.0	4.02	23.92
GZ 4255-8-1	Inc. x Jap.	7.9	4.06	27.39
Telle Hamsa	Indica	12.0	3.92	23.32
Average		5.8	3.50	21.11

* Commercial entries.

Table 2. The relationship between protein content, rice stem borer infestation and source of entries .

Source	Japonica entries	Indica entries or Indica x Japonica	Commercial entries
% Infestation	4.6	7.6	5.4
% Protein	20.3	22.0	20.7

Table 3. The relationship between total protein content of different rice entries and damage caused by *H.prosternalis* .

Entry		DLA	Nitrogen	Protein
Name	Source	%	%	%
Todorokiwase	Japonica	0.24	3.46	20.59
Giza 159	Japonica	0.26	3.83	22.79
Kagahikari	Japonica	0.30	3.09	18.39
GZ 4255-6-4	Ind.X Jap.	0.27	3.46	20.59
Giza 176	Japonica	0.29	2.96	17.61
GZ 4386-34-3	Japonica	0.58	3.06	18.21
GZ 4565-S-10	Ind.X Jap.	0.22	3.53	21.00
IR 40	Indica	0.23	3.09	18.39
Giza 171	Japonica	0.52	4.02	23.92
GZ 4255-8-1	Inc. x Jap.	0.27	4.06	27.39
Telle Hamsa	Indica	0.25	3.92	23.32
Average		0.31	3.50	21.11

Table 2. The relationship between protein content, rice stem borer infestation and source of entries .

Source	Japonica entries	Indica entries or Indica x Japonica	Commercial entries
% DLA	0.37	0.25	0.33
% Protein	20.3	22.0	20.7

This negative correlation can be noticed in GZ 4255-8-1 entry which had low infestation (0.27 % DLM) and the highest protein content (27.39 %), and Gz 4386-34-3 entry which had the highest infestation (0.58 % DLA) and low protein content (18.21%). The same negative correlation appeared in GZ 4565-S-10 and Giza 176 entries. On the other hand, few entries showed a relatively positive correlation like Giza 171 and Todorokiwase. Some entries had the same value of infestation but differed in protein contents (GZ 4255-6-4 and GZ 4255-8-1), while others had different infestation values in spite of the same protein content (Kagahikari and IR 40). These results indicate that protein plays a role in plant resistance but it is not the limiting factor.

Data summarized in table 4 indicated that entries of Indica sources are less infested (0.25 % DLA) with higher protein content (22 %), but those of Japonica source showed higher infestation (0.37 % DLA) and less protein content (20.3%) (Tantawi, 1982).

B. Silica content and insect infestation correlation

As for RSB insect, table 5 showed the relationship between silica content and the percentage of RSB damage as an average of two sowing date results. There was an insignificant negative correlaton between damage and silica content (r = -0.13). The most susceptible entries Gz 4255-3-1 and Telle Hamsa which showed higher percentage of damage (17.1 and 15.4%) had lower silica contents (6.6 and 6.2 mg/100g dry weight, respectively), while the resistant entries GZ 1368-S-5-4 and IR 40 which showed lower percentage of damage (3.2 and 3.0 %) had higher silica contents (10.2 and 9.5 mg, respectively). However, other entries (Todorokiwase and Kagahikari), in spite of their low silica contents (5.5 and 6.2 mg), received low percentages of damage (2.6 and 2.7%, respectively).

For RLM insect, table 6 showed the correlation between silica contents and the percentage of damaged leaf area (DLA %) of RLM insect. The statistical analysis indicated that there was an insignificant negative correlation between silica content and RLM damage (r=-0.23). Some entries showed this correlation as IR 28 that received low infestation (0.30 % DLA) and highest amount of silica (10.4 mg/100 g). While Giza 171 entry, of the highest infestation (0.82 % DLA), contained a low amount of silica (6.0 mg). GZ 4122-23-4-2 and IR 40 rice entries had high silica contents (9.0 and 9.5 mg, respectively) and were subjected to low RLM damage (0.35% for both), whereas Kagahikari and GZ 4255-3-1 entries had low silica (6.2 and 6.6 mg) and showed high RLM infestation (0.57 and 0.56%, respectively). Some

Table 5. Relationship between silica content in different entries and the percentage of damage by rice stem borer *C.agamemnon Bles* .

Entry	% Damage	Silica content mg/100 g dry weight
Giza 171	5.2	6.0
Giza 176	6.1	8.7
GZ 4255-3-1	17.1	6.6
GZ 4386-34-3	8.2	7.0
Telle Hamsa	15.4	6.2
GZ 4255-6-4	4.2	8.0
Kagahikari	2.7	6.2
TKY 1024	5.1	6.0
Todorokiwase	2.6	5.5
IR 40	3.0	9.5
Giza 172	6.8	6.2
GZ 1368-S-5-4	3.2	10.2
IR 28	6.6	10.4
GZ 4565-S-6	9.0	8.5
GZ 4255-9-1	6.6	9.0
GZ 4122-23-4-2	14.0	8.3
GZ 4127-2-1-3	4.0	7.2
GZ 4294-10-4	4.2	8.1
Giza 180	3.9	7.5

other entries, Giza 172 and GZ 4127-1-3 showed low RLM infestation (0.18 and 0.24% DLA) in spite of their low silica contents (6.2 and 7.2 mg, respectively). On the other hand, GZ 1368-S-5-4 rice entry received high infestation (0.52%), though it had high silica content (10.2 mg/100g).

It was apparent that silica in some entries may play an important role as a chemical resistance factor against RSB and RLM insects. This phenomenon could have been due to the unsuitability of the plants with high silica contents for larval survival and development as reported by Ukwungwu (1984) and Ukwungwu and Odobiyi (1985). Silica is not the only factor involved in rice insect resistance, but other resistance factors may share it.

Table 6. Relationship between silica content in different entries and the percentage of damage by rice leaf miner *H. prosternalis* Deem .

Entry	% Damaged leaf area	Silica contet mg/100 g dry weight
Giza 171	0.82	6.0
Giza 176	0.39	8.7
GZ 4255-3-1	0.56	6.6
GZ 4386-34-3	0.72	7.0
Telle Hamsa	0.46	6.2
GZ 4255-6-4	0.51	8.0
Kagahikari	0.57	6.2
TKY 1024	0.37	6.0
Todorokiwase	0.43	5.5
IR 40	0.35	9.5
Giza 172	0.18	6.2
GZ 1368-S-5-4	0.52	10.2
IR 28	0.30	10.4
GZ 4565-S-6	0.43	8.5
GZ 4255-9-1	0.35	9.0
GZ 4122-23-4-2	0.43	8.3
GZ 4127-2-1-3	0.24	7.2
GZ 4294-10-4	0.59	8.1
Giza 180	0.72	7.5

C. Free amino acid (FAA) contents and insect infestation correlation

Little has been done about the possible role of free amino acids in susceptibility of rice plant. Therefore, this study is an attempt to correlate the contents of certain amino acids with the susceptibility of rice entries for RSB and RLM infestation.

Concerning RSB insect,Table 7 showed the relationship between certain FAA contents and RSB damage. Results indicated that there was an insignificant negative correlation between (ornithine + lysine) content and the percentage of damage (r=-0.15). Most of rice entries that had low (ornithine + lysine) content (5mg/100 g dry wt.) received high infestation but those which had high content (10 mg) received low infestation. The contents of (histidine + arginine) were also insignificantly negalively correlated with the damage (r = -0.27). For example, the susceptible entries GZ 4255-3-1 and Telle Hamsa (17.1% and 15.4% damage) contained less amounts of these two amino acids (6.06 and 14.42 mg) than in the resistant entries Giza 176 (6.1 % damage) and TKy - 1024 (5.1 % damage) with (56.2 mg for both). The same correlation was found between (aspartic + serine) contents and insect damage (r=-0.14). The maximum amount of these amino acids (94.58 mg) was found in the resistant entry Giza 176 (6.1 % damage), while these amino acids decreased to 23.82 mg in the susceptible one, Telle Hamsa (15.4 % damage). Glycine contents and insect damage followed the same correlation (r = - 0.07). TKY 1024 entry received low damage (5.1%) and had high glycine content (85.0 mg), while Telle Hamsa entry received higher damage (15.4 %) and had lower glycine content (35.1 mg). Glutamic acid showed an insignificant positive correlation in different tested entries (r=0.13). GZ 4122-23-4-2, TKY 1024 and Todorokiwase were the best examples for this correlation. As for the other amino acids, some were negatively correlated with the insect damage i.e., valine (r=-0.31), alanine (r=-0.29), methionine (r=-0.29) and phenylalanine (r=-0.01). Telle Hamsa and Todorokiwase are good examples for this correlation. Some other entries which were positively correlated with the insect damage i.e., proline (r = 0.19), leucine (r=0.14) and tryptophane (r = 0.08), and GZ 4255-3-1, and Giza 180 entries are good examples for this correlation.

For RLM insect, table 8 showed the relationship between amino acid contents and the percentage of damaged leaf area (DLA %) of RLM insect. The statistical analysis showed that this correlation is either positive i.e., some amino acids increase damage as they increase, or negative i.e., some others decrease the damage as they increase. The amino acids that decrease the damage, in order, are (ornithine + lysine) r =-0.44, alanine r=-0.29, phenylalanine r=-0.20, glutamic acid r =-0.18 (histidine + arginine) r =-0.14, methionine r =-0.09, and glycine r =-0.07. The other amino acids, that increase the insect damage, in order, are tryptophan r=0.32, proline r=0.20, leucine r=0.18, (aspartic + serine) r = 0.05 and valine r =0.04. For more elucidation, (ornithine + lysine) were mentioned to have the highest negative effects r =-0.44. The results showed that the entries with higher contents of these two amino acids (10.00 mg), which are Giza 176; IR 40 and Giza 178, had lower insect damge (0.39, 0.35 and 0.18% DLA, respectively) and vice versa. Tryptophan was found to show the highest positive correlation r = 0.32. Data also showed that the maximum value of tryptophan (53.64 mg) was in the susceptible entry GZ 1386-

Table 7. Relationship between amino contents in different entries and the percentage of damage by the rice sterm boer C.agamemnon.

Entries / Free amino acid (mg/100g dry wt.) and damage	Giza 171	Giza 176	GZ 4255 -3-1	GZ 4386 -34-3	Telle Hamsa	GZ 4255 -6-4	Kagah-ikari	TKY 1024	Todoro-kiwase	IR 40	Giza 172	GZ 1368 - S-5-4	IR 28	GZ 4565 - S - 6	GZ 4255 -9-1	GZ 4122 -23-4-2	GZ 4127-2-1-3	GZ 4294 -10-4
Ornithine + Lysine	5.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Histidine + Arginine	14.42	56.20	6.06	47.85	14.42	22.77	22.77	56.20	31.13	39.49	22.77	47.85	6.06	14.42	22.77	31.13	22.77	14.42
Aspartic + Serine	55.98	94.58	30.25	81.71	23.82	30.25	36.68	88.14	68.85	49.55	30.25	68.85	4.52	36.68	49.55	62.41	36.68	43.12
Glycine	20.00	50.00	35.00	50.00	35.10	30.00	45.00	85.00	60.00	25.00	25.00	50.00	5.00	25.00	35.00	29.00	25.00	20.00
Glutamic acid	9.23	9.23	4.10	9.23	4.10	4.10	4.10	4.10	4.10	24.63	9.23	29.76	4.10	9.23	4.10	50.29	24.63	4.10
Alanine	7.05	27.06	13.72	27.06	13.72	23.72	43.73	60.40	40.40	13.72	7.05	57.07	7.05	33.73	17.05	33.73	30.39	23.72
Proline	33.30	33.30	60.40	60.40	33.30	46.85	46.85	60.40	46.85	33.30	33.30	60.40	33.30	46.85	46.85	46.85	33.30	33.30
Methionine	2.09	2.09	2.09	2.09	2.09	16.49	16.49	35.69	21.29	2.09	2.09	2.09	2.04	2.04	6.89	11.64	6.89	16.49
Valine	17.39	10.50	10.50	17.39	3.62	7.06	13.95	27.72	34.60	13.95	7.06	17.39	7.06	27.72	7.06	3.62	10.50	7.06
Tryptophan	34.18	34.18	34.18	34.18	8.24	8.24	8.24	14.72	14.72	14.72	14.72	53.64	8.24	34.18	8.24	8.24	8.24	8.24
Phenylalanine	9.23	9.23	19.36	9.23	9.23	9.23	9.23	29.48	39.60	9.23	19.36	19.36	9.23	19.36	9.23	9.23	9.23	9.23
L'eucine	6.20	6.20	6.20	1.94	1.94	1.94	1.94	10.46	6.20	6.20	1.94	1.94	1.94	6.20	1.94	6.20	1.94	1.94
% Damage	5.20	6.10	17.10	8.20	15.40	4.20	2.70	5.10	2.60	3.00	6.80	3.20	6.80	9.00	6.60	14.00	4.00	4.20

S-5-4 (0.52 % DLA), while this decreased to 8.24 mg in the resistant one GZ 4127-2-1-3 (0.24 % DLA).

As a general result, most of the high concentrations of the negatively effected amino acids (alanine, histidine + arginine, glycine and aspartic + serine) increase the plant resistance against RSB infestation and so do (ornithine + lysine, histidine + arginine, glutamic and methionine) against RLM infestation. There is a possibility that these compounds possess inhibitory effect on insect feeding or growth and thus reduce the damage inflicted on the plant. While most of the high concentrations of the amino acids of the positive effects (leucine and proline) decrease the plant resistance against RSB infestation and so do (tryptophan, valin, leucine, proline and aspartic + serine) against RLM infestation. That may be due to certain activating effects of these amino acids on plant growth to become more attractive for insect attack (Kamano, 1971). Some entries had low infestation in spite of having low toxic amino acid content which may due to other chemical, morphological and/or histological resistance factors that decreased the host preference and/or increase the acids effects.

Generally, free amino acids are important biotic factors influencing the bionomic and physiological functions of insects. Amino acids quality and quantity play a great role in this respect. Ishii and Hirano (1955) proved that leucine, methionine, and tryptophane are indispensable for RSB growth which is in agreement with the present study. Kamano (1971) mentioned that some amino acids are important for growth and differed according to their kinds.

It can be concluded that amino acid contents may affect RSB and RLM infestation, but they are not the only factor that affect the plant resistance, and other factors share in this respect.

Table 8. Relationship between amino acid contents in different entries and the percentage of damage by the rice sterm boer C.agamemnon.

Entries / Free amino acid (mg/100g dry wt.) and damage	Giza 171	Giza 176	GZ 4255 -3-1	GZ 4386 -34-3	Telle Hamsa	GZ 4255 -6-4	Kagah-ikari	TKY 1024	Todoro-kiwase	IR 40	Giza 172	GZ 1368 - S-5-4	IR 28	GZ 4565 - S - 6	GZ 4255 -9-1	GZ 4122 -23-4-2	GZ 4127-2-1-3	GZ 4294 -10-4
Ornithine + Lysine	5.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Histidine + Arginine	14.42	56.20	6.06	47.85	14.42	22.77	22.77	56.20	31.13	39.49	22.77	47.85	6.06	14.42	22.77	31.13	22.77	14.42
Aspartic + Serine	55.98	94.58	30.25	81.71	23.82	30.25	36.68	88.14	68.85	49.55	30.25	68.85	4.52	36.68	49.55	62.41	36.68	43.12
Glycine	20.00	50.00	35.00	50.00	35.00	30.00	45.00	85.00	60.00	25.00	25.00	50.00	5.00	25.00	35.00	29.00	25.00	20.00
Glutamic acid	9.23	9.23	4.10	9.23	4.10	4.10	4.10	4.10	4.10	24.63	9.23	29.76	4.10	9.23	4.10	50.29	24.63	4.10
Alanine	7.05	27.06	13.72	27.06	13.72	23.72	43.73	60.40	40.40	13.72	7.05	57.07	7.05	33.73	17.05	33.73	30.39	23.72
Proline	33.30	33.30	60.40	60.40	33.30	46.85	45.85	60.40	46.85	33.30	33.30	60.40	33.30	46.85	46.85	46.85	33.30	33.30
Methionine	2.09	2.09	2.09	2.09	2.09	16.49	16.49	35.69	21.29	20.09	2.09	2.09	2.04	2.04	6.89	11.64	6.89	16.49
Valine	17.39	10.50	10.50	17.39	3.62	7.06	13.95	27.72	34.60	13.95	7.06	17.39	7.06	27.72	7.06	3.62	10.50	7.06
Tryptophan	34.18	34.18	34.18	34.18	8.24	8.24	8.24	14.72	14.72	14.72	14.72	53.64	8.24	34.18	8.24	8.24	8.24	8.24
Phenylalanine	9.23	9.23	19.36	9.28	9.23	9.23	9.23	29.48	39.60	9.23	19.36	19.36	9.23	19.36	9.23	9.23	9.23	9.23
Leucine	6.20	6.20	6.20	1.94	1.94	1.94	1.94	10.46	6.20	6.20	1.94	1.94	1.94	6.20	1.94	6.20	1.94	1.94
% Damage	0.82	0.39	0.56	0.72	0.46	0.51	0.57	0.37	0.43	0.35	0.18	0.52	0.30	0.34	0.35	0.43	0.24	0.59

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تأثير بعض المكونات الكيميائية فى نبات الأرز وموطنه الأصلى على درجة مقاومته لثاقبة ساق الأرز وصانعة الأنفاق

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تم زراعة أصناف وسلالات مختلفة من الأرز معلومة الموطن، وتم تقييمها ضد حشرتى ثاقبة ساق الأرز وصانعة الأنفاق لمعرفة درجة إصابتها، كما تم تحليلها كيميائيا لتقدير كل من البروتين الخام والسلكا الخام وخمسة عشر حمض أمينى حر فى كل صنف وبالتحليل الإحصائى تم حساب الإرتباط بين هذه المكونات والإصابة فى كل صنف ، وتم الحصول على النتائج التالية :

– البروتين يزيد الاصابة بثاقبة ساق الأرز فى معظم الأصناف المختبرة بنسبة ارتباط (ر = ٤٥,٠)، بينما تقل الإصابة بصانعة الأنفاق فى معظمها بنسبة إرتباط (ر = ٧٧,٠).

– السلكا تقلل الإصابة بكلتا الحشرتين فى معظم الأصناف المختبرة بنسبة ارتباط (ر = -١٣,٠ للثاقبة ، = ٢٣,٠ لصانعة الانفاق).

– الأحماض الأمينية الحرة أظهرت تأثيرات مختلفة حسب التركيز ونوع الحشرة. فبعضها مثل الآلانين ، جليسين، هستدين مع الأرجنين ، الأسبارتيك مع السيرين ، والفالين قللت الاصابة بثاقبة ساق الأرز فى معظم الاصناف وبدرجات ارتباط مختلفة ، وبعضها الاخر مثل الاورنيثين مع الليسين ، هستيدين مع الأرجنين ومثيونين قد قللت الإصابة بصانعة الأنفاق بدرجات ارتباط متفاوتة . وهناك أحماض أخرى أدت الى زيادة الإصابة باى من الحشرتين .

– الأصناف اليابانية الاصل اكثر مقاومة لثاقبة ساق الارز من الهندية ، بينما الاصناف الهندية كانت اكثر مقاومة لصانعة الانفاق من اليابانية مع وجود نسبة اقل من البروتين فى الاصناف المقاومة.

وعلى ذلك يمكن القول بان بعض المكونات الكيميائية قد تلعب دورا فى المقاومة الصنفية لكنها ليست هى العامل المحدد لها بل يشاركها فى ذلك عوامل مورفولوجية وهستولوجية وجينيه اخرى.