SUSCEPTIBILITY OF CERTAIN RICE VARIETIES TO INFESTATION, WITH THE RICE STEM BORER, CHILO *AGAMMEMNON* BLES.

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ABSTRACT

This study was conducted at the experimental farm of Rice Research & Training Center, Economic Entomology Dept., and Soil Science Dept., Kafr El-Sheikh Fac. of Agric., Tanta University during two successive seasons; 2003 and 2004. Susceptibility to infestation with the rice stem borer *Chilo agamemnon* Bles. of the three hybrid rice genotypes and Sakha 101 rice variety indicated that Sakha 101 was the least susceptible (1.00% damage). On the other hand, the most susceptible rice hybrid was SK 2025H 11.15% damage, it received more eggs than Sakha 101 cultivator. Fertilized rice plants with high levels (80 unit) of nitrogen had higher infestation than that manured with the lower (40 or 60 units) levels. However, to minimize insecticide applications in rice fields and meanwhile to obtain satisfactory rice yield, it is recommended to use 6 kg carbofuran / fed.

The relationship between morphological characters and infestation was studied. Significant positive correlations were found between rice stem borer infestation and each of flag leaf length, flag leaf width and plant height. By contrast, significant negative correlations were found between the infestation and heavy tillering. In the present work, the relationships between some chemical components and damage caused by *Chilo agamemnon* were studies. The high values of infestation were detected in rice varieties having low silica contents and By contrast, varieties suffering low infestation had the highest silica content. Zinc content of rice stem had also negative effects on rice stem borer damage. In the current study, iron negatively correlated with percentage of infested stems. By contrast, potassium, pH, phosphorus, manganese positively correlated with the infested stems.

INTRODUCTION

Rice stem borer, *Chilo agamemnon* Bles. is one of the most constraints in rice production in Egypt (Sherif 2002). The insect attacks the plants during vegetative stage causing dead hearts, and during reproductive stage resulting in white heads. Rice stem borer, *C. agmemnon* infestation causes dead hearts and white heads, however, the latter symptom is the main causal of losses. Mesbah and Sherif (1999) determined 7% white heads as an economic threshold for rice stem borer. On the other hand Isa (1989) concluded that the rice stem borer *C. agmemnon* infestation was positively correlated with rice stem diameter, and width of rice leaves, but negatively correlated with stem hardness, tillering capacity and tightness of leaf sheath around the stem. He added that varieties with green or dark green leaves received more egg masses than varieties with light green leaves. In general, rice varieties belonging to Indica type are more susceptible to stem borer than those belonging to Japonica or Indica x Japonica type (Bleih *et al.*, 1991 and Sherif, 1996). Abdallah and Badawi (1990) found that the percentage of infestation increased with increasing nitrogen levels. In general, nitrogen fertilizers increased the softness and succulence of rice stems and consequently increased the rice stem borer infestation. Soliman *et al.* (1997) studied the effect of rice plant content of silica and protein on rice stem borer, *C. agamemnon* infestation. Mohamed *et al.* (1998) found that concentration of Fe and Mn were high in the rice plants of the high level of nitrogen fertilization. Silica, provided by addition of slag, plowing-under of straw, or from irrigation water, hardens stems, making the crop resistant to stem borer larval feeding (El-Samahy 2002). Developing insect-resistant rice varieties is a valuable role that should be achieved through the cooperation between entomologists and plant breeders. Accordingly, mechanisms of resistance of rice plants against economic insects should be precisely investigated.

The present work was carried out during 2003 and 2004 seasons at the experimental farm and laboratory of Faculty of Agriculture, Kafr El-Sheikh, Tanta University and Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh the objectives of this study were as follows:

1. Evaluating susceptibility of some rice varieties to infestation with, the rice stem borer.
2. Effect of fertilizer and insecticide application on the infestation level and rice grain yield.
3. Studying rice plant characters that influence the infestation with the rice stem borer.

MATERIALS AND METHODS

1. Susceptibility of certain rice varieties to infestation with the rice stem borer:

Two experiments were carried out to estimate the rice stem borer infestation to three rice hybrid as well as to Sakha 101 variety. Also, oviposition preference of borer females on the tested materials was investigated.

1.1. Infestation of the rice varieties:

An area of about 1/3 fed. was divided into plots (2x5 m. each). Four varieties (Sakha 101, SK 2034H, SK 2046H and SK 2025H), new type, highly yield and use commercial were sown in nurseries on May 20th 2003 season and on May 12th 2004 season, and transplanted in three replicates distributed in completely randomized block design. All the recommended agricultural practices were followed after transplantation. Rice plants were kept free from any insecticide and herbicide applications.

Rice plants were evaluated to the rice stem borer infestation on the basis of two symptoms, dead hearts (D.H.) and white heads (W.H). Dead hearts were evaluated 40 days after transplanting, afterwards white heads were evaluated three weeks before harvest. The individual plot was fertilized at the rate of (60 unit of nitrogen) per feddan. For each evaluation, 25 hills were pulled out from each plot. Total number of tillers, and those having dead heart or white head symptom were counted. Dead heart or White head percentage was estimated as follows: Dead heart (D.H.) or White head (W.H.) % = No. of D.H. or W.H. / Total number of panicles x 100.

1.2. Rice varieties preferred to ovipositon preference:

The experiment was conducted under conditions similar to those of the field. Four rice varieties (Sakha 101, SK 2034H, SK 2046H and SK 2025H) were studied for oviposition preference of *Chilo agamemnon* females. Four pots (of the four variety) were arranged in a completely randomized block design inside a wooden frame cage covered with gauze. Five cages were used in this free choice test as replicates. Five pairs of newly emerged moths taken from a laboratory culture, were liberated on Agu., 20th into each cage. Four days later, eggs laid on leaves of each variety were counted. In another obligatory test, the moths (5 pairs) were allowed to lay the egg on two hills of only one variety (3 replicates /variety). Observations on oviposition were also recorded four days after the release of moths. These observations included different parameters viz., (i) number of egg masses and (ii) number of egg per mass. The pupae were weighed.

2. Effect of infestation on the rice grain yield:

2.1. Effect of fertilizers on the infestation levels and rice grain yield:

Study the effect of three different levels of nitrogen application and three promising transplanted hybrid rice varieties and Sakha 101 on the degree of natural stem borer infestation. Strip plot experimental design with four replicates were used. Nitrogen levels; 40, 60 and 80 UN/feddan were randomly placed over the other strip. The experiments were conducted with three doses of urea. Each dose of urea was included in the experiments separately to study its effect on rice stem borer infestation during two successive seasons. Six samples, each consisted of twenty rice hills were taken at random from each treatment. Plants were carefully dissected to estimate the rate of borer infestation. Percentage of dead hearts, white heads and the average number of tillers/hill were also recorded.

2.2. Effect of insecticide applications on the infestation levels and rice grain yield:

Hybrid rice (SK 2034H, SK 2046H and SK 2025H) and Sakha 101 varieties were sown on May 20th 2003 season and on May 12th 2004 season, and transplanted one month. One of the simple methods for the yield loss assessment of rice is the comparison of insecticide treated and untreated plots (Mesbah and Sherif 1999). The experimental field (720 m^2) was prepared for this study and divided into 108 plots. Carbofuran (Furadan 10% G rate 3 kg) was broadcast in 36 plots, and rate 6 kg was broadcast in the other 36 plots. Insecticides were applied one week before heading at 2 rates per feddan in addition to a check (untreated), and completely randomized block design was followed with three replicates. For carbofuran, the applied doses were 3 and 6 kg/fed. Two weeks prior to harvest, plants having white heads, in an area of 1 m^2 in each plot, were counted, and percentages of white heads were calculated relative to total plants in the same 1 m^2. One square meter in the middle of each plot was harvested, and rice grain yield was estimated, and adjusted to one feddan.

RESULTS AND DISCUSSION

1. Susceptibility of some rice varieties to infestation with the rice stem borer

1.1. Infestation of rice varieties:

Data presented in Table (1) showed the susceptibility of tested rice varieties to the rice stem borer, *C. agamemnon* presented as dead hearts, in 2003 and 2004 rice seasons. Averages of dead hearts in 2003 season ranged between 1.00% (for Sakha 101) and 14.60% (for SK 2025H). Thus, Sakha 101 was the least susceptible variety, followed by SK 2046H (5.43%) and SK 2034H (9.23%). On the other hand, the highest susceptible was SK 2025H (14.60% dead heart). Statistical analysis revealed that the differences among evaluated rice varieties were highly significant. The same trend was obtained in the second season 2004, (Table 1); SK 2025H, SK 2034H, SK 2046H and Sakha 101 being infested with values of 15.60, 8.27, 4.85 and 0.95%, respectively. Average of both seasons (Table 1) indicated that SK 2025H was the most susceptible variety (15.10% DH), followed by SK 2034H (8.75% DH) and then SK 2046H (5.14 % DH). On the other hand, the lowest infested variety was Sakha 101(0.98 % DH).

Evaluating rice cultivars to white heads, in 2003 season (Table 1) indicated that SK 2025H was the highest infested variety (16.29% WH), followed by SK 2034H (10.87%WH), and SK 2046H (7.75% WH). The lowest infested cultivar was Sakha 101 (1.58% WH). In 2004 rice season, the same trend was detected, for SK 2025H being the highest infested variety followed by SK 2034H and SK 2046H and Sakha 101, respectively. Average of both seasons (Table 1) revealed that SK 2025H, SK 2034H and SK 2046H received the highest infestation, 16.75%, 10.01% and 7.03% white head, respectively. The lowest infested cultivar was Sakha 101 (1.37% WH). Indica (SK 2025H, SK 2034H and SK 2046H) rice varieties proved to be higher susceptible to the rice stem borer in the current investigation, while Japonica cultivar (Sakha 101) was the lowest. This finding is in agreement with those of Bleih *et al.* (1991), Sherif and Bastawisi (1997). Most of Indica rices have stems with large diameter. It was concluded by Isa (1989) that rice stem borer, *C. agamemnon* infestation was positively correlated with stem diameter.

Table (1): Susceptibility of certain rice varieties to rice stem borer infestation, evaluated as dead hearts and white heads.

Variety	Group	Dead hearts (%)			White heads (%)		
		2003	2004	Means	2003	2004	Means
Sakha 101	Japonica	1.00 d	0.95 d	0.98	1.58 d	1.15 d	1.37
SK 2034H	Indica	9.23 b	8.27 b	8.75	10.87 b	9.14 b	10.01
SK2046H	Indica	5.43 c	4.85 c	5.14	7.75 c	6.30 c	7.03
SK 2025H	Indica	14.60 a	15.60 a	15.10	16.29 a	17.20 a	16.75

In a column, means followed by a common letter are not significantly different at the 5% level by DMR.

1.2. Rice varieties preferred to ovipositon preference:

Data in Table (2) showed that the numbers of eggs laid on SK 2025H, SK 2034H, SK 2046H were 1006 eggs (72 egg-masses), 665 eggs (47 egg-masses) and 358 egg (29 eggs-masses), respectively. The least number of eggs was laid on Sakha 101 (21 eggs) (free choice test). In no choice test, it was found that the least number of egg masses (41) or eggs (71) was recorded for Sakha 101 while Sk 2025H received the highest numbers of egg masses and eggs (142 and 1829, respectively). Preference of females for oviposition in the tested varieties followed the same trend of infestation previously reported in the earlier work of Abd El-Rahman (1984). It could be concluded that the SK 2025H, SK 2034H and SK 2046H (Indica type), were more susceptible to *C. agamemnon* than Sakha 101 (Japonica type). Sherif (1996) reported that Japonica rices are more resistant to *C. agamemnon* than Indica rices. In the same trend, Sherif and Bastawisi (1997) reported that the larvae of *C. agamemnon* obtained from Indica rices were heavier than those obtained from Japonica rices. Generally, the highest number of egg masses and the heaviest pupal weight was obtained when the insect was reared on SK 2025H (32.40 mg). On the opposite side, the lowest number of egg masses and the least pupal weight (20.70) was found for japonica variety Sakha 101.

Table (2): Oviposition of *C. agamemnon* moths on different rice genotypes under two tests, free choice and obligatory (2 hill / genotype).

Variety	Free choice		Obligatory		Av.pupal weight(mg)
	No. of egg masses	No. of eggs	No. of egg masses	No. of eggs	
Sakha 101	13	21	41	71	20.70
SK 2034H	47	665	80	1014	28.50
SK 2046H	29	358	54	648	25.10
SK 2025H	72	1006	142	1829	32.40

2. Effect of infestation on the rice grain yield

2.1. Effect of fertilizers on the infestation levels and rice grain yield:

The effect of nitrogenous fertilizers on the degree of borer infestation and the percentage of dead hearts and white heads were verified. The obtained results are tabulated in Table (3). Nitrogen enhances the nutritional status of both plants and pests (Abdallah and Badawi 1990). It improves plant physiological processes and augments growth rates.

Abdalla and Badawi (1990) reported that *C. agamemnon* infestation increased with increasing nitrogen levels. Results in Table (3) showed clearly that the rice stem borer incidence increased steadily with the increase of supplied nitrogen.

The highest level of nitrogen (80 unit/feddan) recorded the highest percentage of rice stem borer infestation (dead heart) as compared with the lower levels (40 and 60 units) (Table 3). The percentages of borer infestation were 0.49, 3.93, 2.69 and 5.87 % for 40 units (Sakha 101, SK 2034H, SK 2046H and SK 2025H, respectively). On the other side, the percentages of borer infestation for 80 units were 1.01%,12.20%, 7.30% and 17.75% (Sakha 101, SK 2034H, SK 2046H and SK 2025H, respectively). The percentage of dead hearts markedly increased when nitrogen was more used, significant differences were found between fertilized of the different treatments.

Data presented in Table (4) of season 2004 were the same as in the previous season. The lowest infestation by dead hearts was detected in plots having 40 units of nitrogen, being 0.35, 3.14, 1.97 and 6.30% for Sakha 101, SK 2034H, SK 2046H and SK 2025H, respectively. The highest infestation was obtained at 80 units of nitrogen / fed. and resulted in 0.99, 10.15, 6.17 and 18.00% dead hearts. Statistical analysis revealed significant differences in dead hearts between the three treatments of nitrogen levels.

The percentage of white heads were 1.55, 13.72, 9.11 and 19.80% for rice entries fertilized with 80 units of nitrogen / feddan (Sakha 101, SK 2034H, SK 2046H and SK 2025H, respectively). Table (3) of season 2003. The highest degree of infestation was recorded for SK 2025H 6.14%, 16.29% and 19.98% (WH) for rice plants with 40, 60 and 80 units of nitrogen, respectively. Increasing nitrogen level from 40 to 80 unit / feddan caused an increase in the percentage of white heads from 6.14% to 19.80%. The percentage of infestation increased with increasing nitrogen levels. Significant differences were found between the percentages of white heads of the different treatments.

Data presented in Table (4) of season 2004 indicated that the highest infestation (2.01, 11.72, 8.00 and 20.11% white heads), were obtained from 80 unit of nitrogen which suffered highest infestation. This means that the highest dosage of the nitrogen increased the infestation and consequently reduced the rice yield. On the other hand, the lowest infested cultivars; were Sakha 101 (0.99, 1.15 and 2.01% for 40, 60 and 80 unit of nitrogen respectively.

Data in Table (3 & 4) show that the highest rice yield (4.72, 5.21, 5.35, 4.7) and (4.81, 5.30, 5.41 and 4.63 t / fed.) for (Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively) were obtained from 60 unit of nitrogen / fed. in both seasons respectively which suffered from (1.15, 9.14, 6.30 and 17.20%) and (1.58, 10.87, 7.75, 16.29) white heads. Indica (Sk 2034H, Sk 2046H and Sk 2025H) rice cultivars proved to be higher susceptible to the rice stem borer in the current investigation, while Japonica cultivars (Sakha 101) was lower susceptible. This finding is in agreement with those of Bleih *et al.* (1991), and Sherif and Bastawisi (1997). Most of Indica rices have stems with large diameter which allows better stem borer larval development. It was concluded by Isa (1989) that rice stem borer, *Chilo agamemnon* infestation was positively correlated with stem diameter and leaf colour. The plots that received high rates of nitrogen were preferred by *Chilo* moths for oviposition and larval growth (Abdallah and Badawi 1990). Nitrogen fertilizers generally increase the softness and succulence of rice stems and consequently increase the stem borer infestation .

Table (3): Effect of some levels of nitrogen fertilizer on the rice stem borer infestation (dead hearts, white heads and grain yield), 2003 rice season.

Variety	D.H. (%)			W.H. (%)					
	40 units	60 units	80 units	40 units	G.yield (t /fed.)	60 units	G.yield (t / fed.)	80 units	G.yield (t / fed.)
Sakha 101	0.49 a	0.98 a	1.01 b	0.98 a	3.97 b	1.58 a	4.72 a	1.55 b	4.30 b
SK 2034H	3.93 a	9.23 b	12.20 c	4.90 a	4.88 b	10.87b	5.21 a	13.72c	5.20 a
SK 2046H	2.69 a	5.43 b	7.30 c	2.70 a	4.99 a	7.75 b	5.35 a	9.11 c	5.30 a
SK 2025H	5.87 a	14.60b	17.75 c	6.14 a	4.20 b	16.29b	4.72 a	19.80c	4.31 b

In a row, means followed by a common letter are not significantly different at the 5% level by DMRT.

Table (4): Effect of some levels of nitrogen fertilizer on the rice stem borer infestation (dead hearts, white heads and grain yield), 2004 rice season.

Variety	D.H. (%)			W.H. (%)					
	40 units	60 units	80 units	40 units	G.yield (t / fed.)	60 units	G.yield (t/ fed.)	80 units	G.yield (t / fed.)
Sakha 101	0.35 a	0.95 a	0.99 b	0.99 a	4.10 b	1.15 a	4.81 a	2.01 b	4.47 b
SK 2034H	3.14 a	8.27 b	10.15 c	3.18 a	5.00 b	9.14 b	5.30 a	11.72c	5.30 a
SK 2046H	1.97 a	4.58 b	6.17 c	2.00 a	5.13 a	6.30 b	5.41 a	8.00 c	5.40 a
SK 2025H	6.30 a	15.60b	18.00 c	6.13 a	4.01 b	17.20b	4.63 a	20.11c	4.27 b

In a row, means followed by a common letter are not significantly different at the 5% level by DMRT.

2.2. Effect of insecticide applications on the infestation levels and grain yield:

Gradual levels of white heads (WH) were induced through the application of different carbofuran (Table 5). Concerning carbofuran (in 2003), damage due to *Chilo agamemnon* was highest (1.58%, 10.87%, 7.75% and 16.29% (WH) Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively, in the insecticide-free plots, and this level was sharply reduced to 0.19%, 5.00%, 3.32% and 7.60% WH when only 3 kg/fed. was broadcast. Statistical analysis revealed significant differences between the check and dose of 3 kg. Further reduction in level of infestation was detected as the dose of carbofuran was doubled to 6 kg /fed. Increase in insecticide dose induced more reductions in white heads, being 0.07, 2.51, 1.58 and 4.30% WH for Sakha 101, SK 2034H, SK 2046H and SK 2025H. Statistical analysis showed significant differences among 3 kg and 6 kg / fed.

Data in Table (5). revealed that the highest infestation by white head was found at the check (untreated) plots, being 1.15, 9.14, 6.30 and 17.20% for (Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively) (in 2004). At 3 kg, white heads were reduced to 0.22, 3.25, 2.00 and 6.60%, with reductions being 80.87, 64.44, 69.69 and 61.63% for (Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively, compared to the untreated plots. The greatest reduction in white heads (93.04, 78.12, 80.95 and 77.44) was obtained at the highest insecticide dosage (6 kg). Statistical analysis showed superiority of 6 kg over all treatments.

Data in Table (6) revealed that the highest rice yield in season 2003 were (5.00, 6.52, 6.72 and 5.70 t / fed.) for Sakha 101, SK 2034H, SK 2046H and SK 2025H, respectively were obtained from 6 kg / fed. which suffered from 0.07, 2.51, 1.58 and 4.30% white heads.

This means that the highest dosage of the insecticide led to the highest rice yield. The yield increases at this dosage were 5.93, 20.09, 21.88 and 17.19% for Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively over the untreated plots season 2003. The second rank of yield increase (4.45, 14.59, 15.32 and 12.10%) were found at 3 kg that suffered 0.19, 5.00, 3.32 and 7.60% white heads for (Sakha 101, SK 2046H, SK 2046H and SK 2025H respectively. Statistical analysis revealed significant differences in rice yield between untreated plots and dosage of 3 kg, but yield of 6 kg was statistically higher than that of the check. On the other hand, yields of doses 3 kg and 6 kg exhibited no significant differences among each other. This finding agrees with that of Arida and Heong (1989) who reported a slight yield increase in plants attacked by one white head, and suggested that rice hills with as many as white heads may compensate for rice borer damage.

Reductions in percentages of white heads reflected increase in rice yield (Table 6). The highest rice yield (5.00, 6.70, 6.81 and 5.57 t / fed.) (2004) were obtained at 0.08, 2.00, 1.20 and 3.88% whit heads for Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively, which means that rice plants performed the highest yield at 6 kg carbofuran (Furadan 10% G). The yield increase at this level of insecticide compared to the check (untreated) were 3.95, 20.90, 21.00 and 16.88%. The second rank of yield increase was that at 3 kg (3.61, 16.53, 17.23 and 13.46% increase) which corresponds with 0.22, 3.25, 2.00 and 6.60% white heads for Sakha 101, SK 2034H, SK 2046H and SK 2025H respectively. However, statistical analysis showed that differences in rice yield among all treatments, including the check, were found significant.

In a conclusion, the aforementioned data for (2003 and 2004 season) showed that percentages of the white heads were highest, more than without insecticide application for the hybrid rice varieties. Rubia and Penning de Vries (1990), using computer simulation models, predicted that up to 20% dead hearts at the vegetative stage could cause no significant reduction in grain yield, while damage at the grain filling stage (white heads) caused an almost proportionate yield reduction. They suggested that spraying against stem borers at the early vegetative stage is often unnecessary since young rice plants can tolerate considerable damage. From the previously results it is recommended to apply carbofuran rate 6 kg / feddan for SK 2034H, SK 2046H and SK 2025H varieties. Insecticide was applied 45 days after transplanting (to avoid the effects insecticides) obtain the highest yield of rice.

Table (5): Reduction in white heads, due to insecticide application with Furdan (2003 and 2004 rice seasons.)

Variety	2003					2004				
	Check	3 kg / fed.		6 kg / fed.		Check	3 kg / fed.		6 kg / fed.	
		%	Reduct-ion %	%	Reduct-ion %		%	Reduct-ion %	%	Reduct-ion %
Sakha 101	1.58 a	0.19 b	87.97	0.07 b	95.57	1.15 a	0.22 b	80.87	0.08 b	93.04
SK 2034H	10.87 a	5.00 b	54.00	2.51 c	76.91	9.14 a	3.25 b	64.44	2.00 c	78.12
SK 2046H	7.75 a	3.32 b	57.16	1.58 c	79.61	6.30 a	2.00 b	69.69	1.20 c	80.95
SK 2025H	16.29 a	7.60 b	53.35	4.30 c	73.60	17.20a	6.60 b	61.63	3.88 c	77.44

In a row, means followed by a common letter are not significantly different at the 5% level by DMRT.

Table (6): Increase in rice yield due to insecticide applications with Furdan (2003 and 2004 rice seasons).

Variety	2003					2004				
	Check	3 kg / fed.		6 kg / fed.		Check	3 kg / fed.		6 kg / fed.	
		Yield t/fed.	Increase %	Yield t/fed.	Increase %		Yield t/fed.	Increase %	Yield t/fed.	Increase %
Sakha 101	4.72 a	4.93 a	4.45	.00 a	5.93	4.81 c	4.99 b	3.61	5.00 a	3.95
SK 2034H	5.21 c	6.10 b	14.59	.52 a	20.09	5.30 b	6.35 b	16.53	6.70 a	20.90
SK 2046H	5.25c	6.20 b	15.32	.72 a	21.88	5.38 b	6.50 a	17.23	6.81 a	21.00
SK 2025H	4.72 c	5.37 b	12.10	5.7 a	17.19	4.63 c	5.35 b	13.46	5.57 a	16.88

In a row, means followed by a common letter are not significantly different at the 5% level by DMRT.

3. Studies on the plant characters

3.1. Relationship between certain rice plant morphological characters and the infestation with the rice stem borer:

Data of the two seasons (2003 and 2004) were found to be of a similar trend, accordingly they were lumped together and means were calculated (Table 7). The data showed pronounced differences in the percentage of the borer infestation among studied varieties. As rice stem borer attacks the crop at early seedling stage, causing dead hearts and at flowering, resulting in chaffy white heads, examining only one stage dose not accurately show the reaction of a variety to the borer.

Data in Table (8). illustrate the relationship between certain plant characters and percentage of infested tillers. Those analysis show that the length and width of the flag were positively correlated with borer susceptibility. Abdallah *et al.* (1987)

confirmed this result, as they indicated that varieties of wide and long leaves were more susceptible to the stem borer.

Table (7): Relationship between morphological characters of rice plant and infestation with the rice stem borer.

Variety	Av. no. of Tillers/hill	Av. plant height (cm)	Flag leaf (cm)		D.H. %	W.H. %
			Length	Width		
Sakha101	25.43	94 cm	23.56	1.10	0.98	1.37
SK 2034H	35.06	110 cm	42.60	1.50	8.75	10.01
SK 2046H	37.00	106 cm	41.18	1.40	5.14	7.03
SK 2025H	33.09	115 cm	43.20	1.70	15.1	16.75

Table (8): Correlation coefficients between dead heart / white head incidence and various plant characteristics.

Symptom of Infestation	No. of tillers/plant	Plant height (cm)	% of W.H.	Flag leaf(cm)	
				Length	Width
D.H. %	0.415	0.936	0.977*	0.692	0.928
W.H. %	0.590	0.980*	---	0.826	0.978*

* significant (P=0.05)

The results indicated that rice infestation with the borer was positively correlated to plant height but negatively related to tillering capacity which agree with those of Abd El-Rahman (1984). Tall varieties, because of their height, might be more attractive to ovipositing moths than short ones. The comparative low borer incidence in heavy tillering varieties may be ascribed to crowdness of plants which may render them less attractive for ovipositing moths. This explanation is sustained by the findings of Sherif (1980).

A remarkable positive correlation between the average length of the rice plants and the degree of borer infestation was recorded. Also, there was a negative correlation between the borer infestation and the average number of tillers / hill. Therefore, the highest borer infestation may be attributed to the length of rice plant and the average number of tillers / hill, i.e. SK 2025H is the longest (115 cm) and had a few number of tillers (33.9) and the highest borer infestation (15.1 D.H. and 16.75 W.H.) On the other side, Japonica variety Sakha 101 was the shortest, (94 cm) in the same time, it had the lowest percentage of infestation Table (7).

This phenomenon may be attributed to the morphological characters of the rice varieties (Table 8) The most resistant Sakha 101 variety have short stems, and narrow short leaves. On the other hand, SK 2025H represented the most susceptible variety which have long stems, low tillering capacity in Indica type, and long wide leaves.

3.2. Chemical analysis of some rice varieties in relation to the infestation with the rice stem borer :

Data presented in Table (9). exhibit the greatly damage varieties were Sk 2046H, Sk 2034H and Sk 2025H with 6.09, 9.38 and 15.93% respectively. The high values of infested were accompanied by the lower percentages of silica; 1.479, 0.945 and 0.357% for the three abovementioned varieties respectively. By contrast, variety Sakha 101 had the low percentages of infested stem; 1.18% exhibited high stem contents of silica; 2.196%.

Table (9): Influence of different plant constituents on the rice stem borer infestation to different rice varieties at different rates of nitrogen.

	Percentage							
Variety	Potassium	pH	Phosphorus	Zinc	Iron	Manganese	Silica %	RSB infestation
Sakha 101	4.50	6.48	0.08	0.0201	0.0601	0.0460	2.196	1.18
Sk 2034H	5.45	6.63	0.16	0.0184	0.0517	0.0512	0.945	9.38
Sk 2046H	5.41	6.53	0.13	0.0222	0.0540	0.0514	1.479	6.09
Sk 2025H	5.82	6.66	0.13	0.0156	0.0488	0.0608	0.357	15.93

Average plant chemical constituents values and percentage of rice stem borer infestation in 2003 and 2004 seasons are presented in (Table 10). Correlation coefficients analyses were carried out on the basis of these plant chemical constituents values of rice and percentage of rice stem borer infestation.

Rice stem borer infestation rate was positively correlated with the presence of potassium (0.921**), pH (0.680**), phosphorus (0.568*) and manganese (0.949**) but negatively correlated with the presence of zinc (-0.754**), iron (-0.963**) and silica (-0.994**)(Table 10). Mishra and Misra (1992), reported negative correlation between silica content of rice and leafhopper, *Sogatella furcifera* infestation. Furthermore, Salim and Saxena (1992), found that high silica and iron contents reduced: intake and assimilation of food, growth, adult longevity, fecundity and population size of *S. furcifera*. Soliman *et al.* (1997), reported that severe damage in rice plants due to *Chilo agamemnon* was reduced by high contents of plant silica. These results indicated that high plant contents of potassium, pH, phosphorus and manganese induced higher stem borer infestation, whereas higher amounts of zinc, iron and silica reduced the infestation rate.

Table (10): Correlation matrix between rice plant chemical constituents and rice stem borer infestation rates.

Variable (plant constituents	Stem pH	Phosph-orus	Zinc	Iron	Manganese	Silica %	RSB infestation
Potassium	0.816**	0.962**	-0.470	-0.976**	0.876**	-0.938**	0.921**
pH		0.431	-0.168	-0.705**	0.793**	-0.655**	0.680**
Phosphorus			-0.253	-0.718**	0.408	-0.640**	0.568*
Zinc				0.614**	-0.653**	0.732**	-0.754**
Iron					-0.883**	0.983**	-0.963**
Manganese						-0.915**	0.949**
Silica							-0.994**

**Correlation is highly significant at the 0.01 level. *Correlation is significant at the 0.05 level.

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الملخص العربى

تقيم حساسية بعض أصناف الأرز للإصابة بثاقبة ساق الأرز (دودة القصب الصغيرة *Chilo agammemnon* Bles.)

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تصيب ثاقبة ساق الأرز محصول الأرز مسببة له خسائر جسيمة لذا كان الهدف من البحث، دراسة حساسية بعض أصناف الأرز الهجين للإصابة بثاقبة ساق الأرز وتأثير كل من التسميد والمبيد على نسبة الإصابة والمحصول الناتج وأيضا مدى ارتباط كل من الصفات المورفولوجية والكيماوية بالإصابة. وذلك للحصول على مزيد من المعلومات التى تساعد فى وضع برنامج مكافحة متكاملة لهذه الآفة الحشرية التى تسبب خسارة فى محصول الأرز فى مصر.

وقد تم إجراء هذه الدراسة فى مزرعة مركز البحوث والتدريب فى الأرز ومعمل الحشرات الاقتصادية بكلية الزراعة بكفر الشيخ – جامعة طنطا خلال المواسم ٢٠٠٣-٢٠٠٤. وقد تم الحصول على النتائج التالية:

١.الحساسية للإصابة بثاقبة ساق الأرز

١. ١.الإصابة بثاقبة ساق الأرز:

أوضحت النتائج أن الصنف سخا ١٠١ كان اكثر الأصناف مقاومة ، حيث بلغت الإصابة (قلوب ميتة + سنابل بيضاء) ١٨و١ %. وعلى الجانب الآخر كانت اكثر الأصناف إصابة هى SK 2025H ، SK 2034H ، SK 2046H حيث بلغت نسبة الإصابة بها ٩٣و١٥ ، ٣٨و٩ , ٨٥٠و٦ % على التوالى .

١. ٢. تفضيل وضع البيض:

أوضحت النتائج أن اكبر عدد من كتل البيض التى تم وضعها كانت للصنف SK 2025H بمعدل ١٠٩٦بيضة (٧٢ كتلة بيض) ، يليه الصنف SK 2034Hبمعدل ٦٦٥ بيضة (٤٧ كتلة بيض) ، ثم الصنف SK 2046Hبمعدل ٣٥٨ بيضة (٢٩ كتلة بيض) . ومن ناحية أخرى ، فقد تم الحصول على اقل عدد من البيض الموضوع من الصنف سخا ١٠١ (٧١ بيضة) من ١٣ كتلة بيض . وتم الحصول على أعلى وزن من العذارى الناتجة من الأصناف SK 2025H ،SK 2034H ،SK 2046Hبمتوسط ٣٠و٢٨ ، ١٥و٢٥ ، ٤٠و٢٢ مجم / عذراء على التوالى . وعلى العكس من ذلك ، فقد أعطى الصنف سخا ١٠١ اقل وزن من العذارى ٧٠و٢٠ مجم لكل عذراء.

١. ٣. تأثير الإصابة على المحصول:

١. ٣. ١. تأثير التسميد:

من دراسة تأثير كمية السماد النيتروجينى المضاف للأرز على معدل الإصابة بثاقبة ساق الأرز. وجد أن: النباتات المسمدة بنسب ٨٠ وحدة من الأزوت قد استقبلت نسبة عالية من الإصابة ، حيث بلغت نسبة الإصابة (قلوب ميتة + سنابل بيضاء) ٣٧و١ ، ٩٥و١١ ، ٦٥و٧ ، ٩٢و١٨ % لكل من سخا ١٠١ ، SK 2034H ، SK 2046H ،SK 2025H ، كما كانت نسبة الإصابة عند ٦٠ وحدة (١٧و١ ، ٣٨و٩ ، ٠٢و٦ ، ٩٢و١٥ %) على التوالى. على الجانب الأخر كانت النباتات المسمدة بنسبة ٤٠وحدة أزوت تحظى بأقل نسبة إصابة

١. ٣. ٢. تأثير المبيدات:

وجد أن انخفاض نسبة السنابل البيضاء بنسبة ٩٧و٨٧ , ٠٠و٥٤ ،١٦و٥٧ ، ٣٥و٥٣ % أدت إلى زيادة المحصول بمقدار ٤٥و٤ ، ٥٩و١٤ ، ٣٢و١٥ ، ١٠و١٢ % للأصناف سخا ١٠١ ، SK 2034H ، SK 2046H ، SK 2025H على التوالى. كما حدثت أعلى زيادة فى المحصول بمقدار ٩٣و٥ ، ٠٩و٢٠ ، ٨٨و٢١ ، ١٩و١٧ % عندما انخفضت السنابل البيضاء بنسبة ٥٧و٩٥ ، ٩١و٧٦ ، ٦١و٧٩ ، ٦٠و٧٣ % على التوالى وذلك عند استخدام المبيد بمعدل ٦ كجم / فدان.

وعلى العموم فانة يمكن التوصية باستخدام المبيد بمعدل ٦ كجم / فدان عندما يكون صنف الأرز المنزرع حساسا للإصابة بثاقبة الساق. إذا اقتضت الضرورة استخدام المبيدات فيجب أن يوضع المبيد بمدة طويلة قبل تكون السنابل منعا لترسيب المبيد فى الحبوب .

٢.دراسات على الصفات النباتية للأرز:

٢. ١. العلاقة بين بعض الصفات المورفولوجية والإصابة بثاقبة ساق الأرز:

تم اخذ الملاحظات الحقلية للقلب الميت بعد ٦٠ يوم من الشتل أما بالنسبة للسنابل البيضاء فقد تم اخذ الملاحظات عنها قبل الحصاد بحوالى ١٠ أيام. وفى كل مرة تم فحص ٢٠ جوره . وقد تم تقدير الصفات التالية: متوسط طول النبات – متوسط عدد الخلفات لكل جوره – طول وعرض ورقة العلم – كذلك تم تقدير الإصابة بالقلب الميت و السنابل البيضاء . وبناء على النتائج المتحصل عليها وجد أن هناك علاقة معنوية موجبة بين كل من طول النبات ، طول وعرض ورقة العلم وبين القابلية للإصابة بثاقبة ساق الأرز.

٢. ٢.التحليلات الكيماوية لأصناف الأرز:

وجد أن أعلى قيمة للإصابة (٩٠و٦ ، ٣٨و٩ ، ٩٣و١٥ %) كانت فى أصناف الأرز المحتوية على نسبة اقل من السيليكا (٤٧٩و١ ، ٩٤٥و٠ ، ٣٥٧و٠%) وعلى العكس من ذلك، فان الصنف سخا ١٠١ الذى أصيب بنسبة اقل (١٨و١%) واحتوى على أعلى نسبة من السيليكا (١٩٦و٢%). كما وجد أيضا أن هناك علاقة عكسية بين الزنك ونسبة الإصابة بالحشرة. حيث كانت قيمة r= -٧٥٤و٠**. كما ارتبط الحديد أيضا بعلاقة عكسية مع الإصابة حيث كانت قيمة r= -٩٦٣و٠**. وكانت هذه العلاقة عالية المعنوية. وعلى العكس من ذلك كانت العلاقة بين البوتاسيوم والفوسفور والمنجنيز ودرجة الحموضة والإصابة بالحشرة إيجابية. حيث كانت قيمة r لكل منهم = ٩٢١و٠ **، ٥٦٨و٠* ، ٩٤٩و٠** ، ٦٨٠و٠** % على التوالى.