

VARIETAL RESISTANCE : BIOLOGICAL EVALUATION AND SCREENING OF CERTAIN RICE ENTRIES AGAINST THE RICE STEM BORER, *CHILO AGAMEMNON* BLES.

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Abstract

Sixteen rice varieties and promising lines were evaluated at two growth stages, for resistance to feeding by the rice stem borer; *Chilo agamemnon* Bles. larvae using laboratory methods. Study reported here showed that :-

A) At tillering stage

Larval mortality: Giza 167, GZ 4294-10-2, Todorokiwase, GZ 4256-7-4-7 and GZ 4122-23-4-2 were the most resistant entries causing from 20.0 to 55.6% larval mortality.

Larval duration: Todorokiwase, GZ 4294-10-2 and Giza 176 were the most resistant entries resulting in longest developmental periods of larvae ranging from 32.3 to 35.2 days.

Pupal duration: Todorokiwase and Giza 176 were the most resistant entries resulting in longest duration periods of pupae ranging from 7.0 to 7.7 days.

Pupal weight: Todorokiwase and Giza 176 appeared to be the most resistant entries resulting in least weights of pupae ranging from 40.2 to 24.6 mg.

Adult longevity: Telle Hamsa and Toride-1 were the most resistant entries with longest adult longevity ranging from 9.0 to 7.6 days.

B) At flowering stage

Larval Mortality : GZ 4071-16-2-1 and Kagahikari were the highest resistant entries causing 42.6 and 35.0% larval mortality.

Larval duration: GZ 4071-16-2-1 and Kagahikari were the highest resistant entries with 34.6 and 33.2 days as longest duration of larval feeding.

Pupal duration: GZ 181 and Kagahikari were the highest resistant entries with longest pupal duration ranging from 8.9 to 7.2 days.

Pupal weight: GZ 4255-3-1 and GZ 4071-16-2-1 showed to be most resistant entries resulting in least weights of pupae ranging from 22.2 to 41.0 mg.

Adult longevity: GZ 4255-3-1 and GZ 4122-23-4-2 were the highest resistant entries showing longest periods for adult longevity ranging from 7.3 to 6.7 days .

Generally, differences of wide magnitude existed among the tested entries, plant stages and sexes of insect. Giza 176, Todorokiwase and Kagahikari were the least suitable entries for the rice stem borer feeding. Tillering stage was less suitable than flowering for the borer survival.

INTRODUCTION

Rice is one of the most important food crops in Egypt. More than one million feddans yearly is planted in the six rice Governorates .

The rice stem borer; *Chilo agamemnon* Bles. is one of the major insects in rice fields. It causes yearly high losses in rice grain yield .

Recently, Scientists are collaborating to produce high yielding, insect resistant rice material. Entomologists have done extensive screening of local and introduced rice germplasm for resistance to insects to identify more sources of resistance. Integrated pest management (IPM) system is the new strategy for entomologists, to achieve their goals. Biological evaluation is one of the three props (field, laboratory and chemical evaluation) that varietal resistance is established on.

This study aims at evaluating resistance of certain rice entries, at tillering and flowering stages, to feeding by rice stem borer larvae and selecting the most antibioticly resistant ones to be incorporated in the breeding programme for producing insect resistant, high yielding varieties .

MATERIALS AND METHODS

The present study was achieved in 1995 in laboratories of Plant Protection Research Institute, Dokki, Giza. The diet used in this work was developed by Isa (1972). In this diet, rice bran was omitted and replaced by the powder of the rice plant. The plant powder was prepared from the stalks of sixteen rice entries. The stalks were air-dried for 48 hr and next in an electric oven held at 60-65°C for 48

hr and ground into fine powder in an electric mill.

Each one of the newly hatched larvae was introduced into a vial. Hundred vials were used as replicates for each entry. The vials were transferred into an incubator held at $27 \pm 1^\circ\text{C}$ and $90\% \pm 5\%$ R.H. until pupation. Rearing was done in complete darkness except for short periods required for observation. These vials were daily inspected to record mortality percentages, larval and pupal duration, pupal weight and adult longevity.

RESULTS AND DISCUSSION

Table (1) showed percentage of larval mortality, mean periods of different insect stages and weights of pupae resulting from rearing *Chilo agamemnon* Bles. larvae on diets with different entry powders at tillering stage.

As percentage of larval mortality measure was used, Giza 176, GZ 4294-10-2, Todorokiwase, GZ 4256-7-4-7 and GZ 4122-23-4-2 entries showed the highest effects (55.6, 51.1, 50.0, 38.0 and 20.0%, respectively), while Telle Hamsa, GZ 4386-34-3, Toride 1 and GZ 4255-6-1 showed the least, (4.3, 6.5, 7.1 and 8.9%), respectively. It is evident that resistance to the rice stem borer in rice plants is expressed as antibiosis, where the larvae die after they begin to feed, (Painter, 1951). This form of resistance is more desirable for protecting plant rice against the borer attack.

Using larval duration measure, Todorokiwase and GZ 4294-10-2 caused relatively the longest periods (35.2 and 32.3 days, respectively), while Telle Hamsa and GZ 4386-34-3 entries caused the shortest (27.0 and 27.7 days), respectively. The highly significant prolongation in larval period may be due to the inability of the larvae to accumulate enough food needed for the normal development.

Concerning the pupal duration, the pupae reared on Todorokiwase took relatively the longest time to produce adults (7.0 and 7.7 days), while GZ 4386-34-3 entry took the shortest (6.0 and 6.0 days) for females and males, respectively, with significant differences.

As for the pupal weight, the mean weight of female and male pupae produced from larvae fed on Telle Hamsa (51.2 and 40.1 mg) was the heaviest, but those fed on Todorokiwase were the lightest (39.3 and 24.6 mg), respectively. The significant

differences may have been due to the relative proportions and interactions of naturally occurring stimulants and deterrents in certain entries according to Munakata and Okamoto (1964) who reviewed the mechanism of resistance in rice plant.

When the adult longevity measure was used, the adults resulted from rearing larvae on diets containing Tell Hamsa stayed the longest period (8.2 and 9.0 days for females and males, respectively), while adults of larvae reared on diets containing Todorokiwase entry lived shortest period (5.2 and 5.0 days for females and males, respectively) .

It can be noticed that there was highly significant prolongation in larval and pupal duration, marked reduction in pupal weights produced from Todorokiwas, GZ 4294-10-2 and Giza 176. This means that some entries retarded growth and development of the rice stem borer as mentioned by Yesu (1976).

Table 1. Effect of some rice entries at tillering stage on biology of *C. agamemnon* .

Entries	Larval Mortality %	Larval duration (day)	Pupal duration (day)		Pupal weight (mg)		Adult longevity (day)	
			Female	Male	Female	Male	Female	Male
Todorokiwase	50.0	35.2 a	7.0 ab	7.0 ab	39.3 f	24.6 c	5.2 fg	5.0 c-c
Gz 4294-10-2	51.1	32.3 b	6.7 a-f	6.7 a-f	42.8 c-f	26.0 bc	6.1 c-f	6.7 b-d
Giza-176	55.6	35.0 a	7.0 ab	7.0 ab	40.2 f	24.6 c	4.3 g	4.5 c
Giza-172	11.0	31.8 b	6.3 f-s	6.3 f-s	45.5 a-f	28.7 ab	6.0 c-f	5.6 b-c
GZ 4122-23-4-2	20.0	31.9 b	6.3 dg	6.3 dg	45.4 a-f	29.1 ab	5.7 cf	6.0 b-c
Gz 4071-16-2-1	14.0	30.3 b-c	6.7 a-f	6.7 a-f	48.6 a-c	27.0 a-c	7.5 a-d	7.3 ab
Kagahikari	14.0	31.2 b-g	6.4 d-h	6.4 d-h	44.5 b-f	27.5 a-c	6.3 b-f	5.0 c-e
Giza - 171	13.2	29.5 b-g	6.1 h	6.1 h	41.3 ef	26.4 a-c	6.3 b-f	5.5 b-c
Gz 4255-3-1	12.0	29.5 b-g	6.9 a-c	6.9 a-c	44.6 b-f	27.2 a-c	6.0 d-f	7.1 a-c
Gz 4255-6-1	12.8	29.4 b-g	6.6 b-g	6.6 b-g	40.2 f	24.9 c	5.7 ef	6.0
Giza - 181	16.0	28.4 c-g	6.1 h	6.1 h	49.1 ab	30.2 a	7.5 a-d	7.3 ab
Gz 4255-6-1	8.9	29.2 c-g	6.2 gh	6.2 gh	45.4 a-c	29.4 ab	7.8 ab	7.6 ab
Gz 4256-7-4-7	38.0	31.6 bc	6.9 a-d	6.9 a-d	48.6 a-c	28.8 ab	7.0 a-e	5.7 b-e
Toridel	7.10	28.9 d-g	6.4 d-h	6.4 d-h	49.0 ab	29.9 a	8.3 a	7.6 ab
Gz 4386-34-3	6.50	27.7 fg	6.0 h	6.0 h	41.7 ef	26.4 a-c	7.6 a-c	7.0 b-c
Tell Hamsa	4.30	27.0 g	6.2 gh	6.2 gh	51.2 a	30.1 a	8.2 a	9.0 a
Mean	20.9	30.6	6.5	6.5	44.8	27.6	6.6	6.4

Values followed by the same letter are not significantly different at the 5% level of DMRT.

Table 2 showed the effect of different rice entries at flowering stage on the biology of the rice stem borer; *Chilo agamemnon* Bles .

As the larval mortality parameter was used, the highest percentages were obtained from rearing the larvae on diets containing powder of GZ 4071-16-1 (42.6%), while the lowest larval death was obtained from rearing the larvae on diets containing GZ 4255-3-1 (2.0 %).

As for the larval duration, it ranged from 27.5 to 34.6 days. The longest mean of larval period occurred in case of GZ 4071-16-2-1 (34.6 days) and Kagahikari (33.2 days), while the shortest was obtained from GZ 4255-3-1 (27.5 days) and GZ 4255-6-1 (27.5 days).

Table 2. Effect of some rice entries at flowering stage on biology of *C. agamemnon* .

Entries	Larval Mortality %	Larval duration (day)	Pupal duration (day)		Pupal weight (mg)		Adult longevity (day)	
			Female	Male	Female	Male	Female	Male
Todorokiwase	35	33.2 a	7.2 b	7.5 bc	40.0 ef	26.7 bc	4.2 c	4.3 cd
Gz 4294-10-2	10	32.7 bc	8.1 a	8.9 a	41.0 d-f	22.2 d	5.6 a-c	6.2 a-c
Giza-176	13	31.9 b-d	7.0 bc	7.3 b-d	43.7 c-f	24.5 cd	7.2 a	6.1 a-c
Giza-172	42.6	34.6 a	6.0 f	6.2 cf	38.1 f	25.1 cd	5.0 c-c	6.8 ab
GZ 4122-23-4-2	12	30.0 dc	7.0 bc	7.3 ef	39.8 ef	26.0 bc	4.2 e	4.5 cd
Gz 4071-16-2-1	12.2	30.1 dc	6.9 b-d	7.3 b-d	40.0 ef	26.3 bc	5.0 c-c	5.3 b-d
Kagahikari	11.5	31.0 b-d	7.0 bc	7.4 bc	43.7 c-f	27.3 bc	5.4 b-c	5.7 a-d
Giza - 171	10.8	29.8 c	7.1 bc	7.8 b	44.6 ab	26.4 bc	4.3 e	3.8 d
Gz 4255-3-1	20.5	30.7 c-c	6.6 a	7.1 cd	47.8 a-c	28.8 ab	6.6 ab	5.6 a-d
Gz 4255-6-1	29.8	32.7 bc	6.6 c-c	7.3 bc	41.0 d-f	26.7 bc	6.1 a-d	4.8 b-d
Giza - 181	12.2	27.5 f	6.2 cf	6.0 f	41.3 c-f	25.1 cd	5.0 c-c	6.8 ab
Gz 4255-6-1	9.8	29.1 ef	6.6 c-e	6.7 de	44.6 a-e	27.3 ab	6.8 ab	6.2 ac
Gz 4256-7-4-7	15.0	31.9 b-d	6.4 d-f	6.7 dc	44.6 a-c	27.5 bc	6.7 ab	6.2 a-c
Toridel	32.0	30.2 de	6.7 b-d	7.5 bc	47.8 a-c	28.8 ab	6.1 a-d	6.2 a-c
Gz 4386-34-3	5.9	27.5 f	6.2 ef	6.7 dc	48.9 ab	31.5 a	7.2 a	6.7 ab
Tell Hamsa	2.0	27.5 f	6.0 f	6.1 ef	49.4 a	31.7 a	7.3 a	6.8 ab
Mean	17.1	30.6	6.7	7.1	43.5	27.0	5.8	5.8

Values followed by the same letter are not significantly different at the 5% level of DMRT.

As the pupal weight measure was used, the mean pupal weight for males was lightest in case of Todorokiwase and Giza 181 (24.5 and 22.2 mg) and for females in case of GZ 4255-8-1 and GZ 4071-16-2-1 (39.8 and 38.1 mg). The pupal weight was heaviest, in both sexes, when the larvae were reared on GZ 4255-3-1 (49.4 and 31.7 mg for females and males, respectively).

The pupal duration was prolonged to 7.2 and 7.5 days for females and males, respectively when larvae were reared on Kagahikari, while it decreased to 6.0 and 6.1 days for females and males, respectively in case of GZ 4255-3-1 entry.

The longevity of adult emerging from larvae reared on GZ 4255-3-1 (7.3 and 6.8 days for females and males, respectively) was the longest, while it was shortest in case of Kagahikari (4.2 and 4.3 days for females and males, respectively).

These data indicated that wide differences existed among the tested entries in their ability to retard growth and development of the borer. This phenomenon could have been due to the unsuitability of the plants (toxic, deterrent and antifeedant substances) for larval survival and development, thereby resulting in reduced population on the resistant entries. These unsuitability characters seem to exist in Todorokiwase, Giza 176 and Kagahikari entries.

As for the effect of the plant growth stage on the insect biology, the response of the borer to most of the tested entries differed as the growth stage differed. Kagahikari caused lower larval mortality at the tillering stage (14%) than at flowering (35%). While Giza 176 caused higher larval mortality at the tillering stage (55.6%) than at flowering (20.5%). These results were confirmed by Israel (1967) who reported that factors responsible for resistance to damage at the different plant stages may be independent. Such factors were stage specificity and the structure of the plant that differ at different stages, (Dhaliwal *et al.*, 1993). Some entries reacted in similar manner for the borer at both stages. GZ 4255-8-1 caused 12.8 and 12.0% larval mortality at the tillering and flowering stages, respectively. The life cycle and weight of pupae were almost similar at both stages, Ukwungwu (1990).

As general view, the resistant entries caused higher mortality, smaller body weight, prolonged larval and pupal periods. The slower rate of development could have two disadvantages to rice stem borer larvae; 1) the longer the period of development the greater the chance that the larvae may fall victim to environment stresses such as predators, parasites and/or adverse weather and 2) the lengthened total growth period for insects on resistant entry may result in late emerging adults

that have difficulty in finding a mate. With resistant entries, all these effects should result in cumulative reduction in rice stem borer subsequent generation, Ukwugwu (1990).

It is important to mention that varietal resistance based on field, chemical and biological evaluation will be used to introduce to the breeder rice entries based on whole plant resistance.

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المقاومة الصنفية: تقييم بيولوجي وانتخاب لبعض أصناف وسلالات الأرز ضد ثاقبة ساق الأرز

على محمود سليمان ، سعدية عبد البصير

معهد بحوث وقاية النباتات - مركز البحوث الزراعية بالجيزة - الدقى .

تم معمليا تقييم المقاومة البيولوجية في ١٦ صنف وسلالة أرز مبشرة - في مرحلتى نمو - لتغذية يرقات ثاقبة ساق الأرز ، وأوضحت الدراسة الآتى :-

(١) فى مرحلة التفريع :

بحساب نسبة الموت اليرقى كمقياس للمقاومة، أثبتت السلالات والأصناف جيزة ١٧٦ ، جى زد (٤٢٩٤ - ٤ - ١٠ - ٢) ، تودوروكيواز ، جى زد (٤٢٥٦ - ٧ - ٤ - ٧) ، جى زد (٤١٢٢ - ٢٣ - ٤ - ٢) انها الأكثر مقاومة ، حيث أعمت أعلى نسبة موت تراوحت بين ٢٠ - ٢٥,٦ %.

وعند حساب مدة الطور اليرقى، كانت الأصناف والسلالات تودوروكيواز ، جى زد (٤٢٩٤ - ١٠ - ٢)، جيزة ١٧٦ هى الأكثر مقاومة ، حيث ادت الى اطالة مدد الطور اليرقى فتراوح ما بين ٣٢,٣ : ٣٥,٢ يوما عند التربية عليها .

بتقدير فترة التعذر ، كان تودوروكيواز ، جيزة ١٧٦ هما الأعلى مقاومة مسببة أطول فترات تعذر تراوحت بين ٧ : ٧,٧ يوما حسب جنس العذراء ونوع النبات.

عند تقدير وزن العذارى ، اظهر تودوروكيواز ، جيزة ١٧٦ اعلى مقاومة كمسببة لاقول الاوزان العذرية والتي انخفضت الى ما بين ٤٠,٢ : ٢٤,٦ مجم.

بتقدير مدة الطور البالغ للحشرة ، كان تلى همسا ، توريد-١ هما الأكثر مقاومة حيث سببا طول مدة الاطوار البالغة والتي تراوحت ما بين ٩ : ٧,٦ يوما.

(ب) فى مرحلة الإزهار :

عند حساب نسبة الموت اليرقى ، أوضحت السلالات جى زد (٤٠٧١ - ١٦ - ٢ - ١) ، كاجاهيكارى انها الأكثر مقاومة حيث أعمت اعلى نسبة موت وصلت الى ما بين ٤٢,٦ : ٣٥ %.

وبالنسبة لمدة الطور اليرقى ، كان جى زد (٤٠٧١ - ١٦ - ٢ - ١) ، كاجاهيكارى هما أيضا الأكثر مقاومة حيث ادت الى طول الاطوار اليرقية والتي وصلت الى ما بين ٣٤,٦ : ٣٣,٢ يوما.

بقياس فترة التعذر ، كان جيزة ١٨٠ ، كاهيكارى هما اكثر الاصناف مقاومة حيث ادت الى طول مدة العذراء الى ما بين ٨,٩ : ٧,٢ يوما.

عند تقدير وزن العذارى ، كان جى زد (٤٢٥٥ - ٢ - ١) ، جى زد (٤٠٧١ - ١٦ - ٢ - ١) هما أكثر مقاومة حيث نتج عنها اقل العذارى وزنا فيما بين ٢٢,٢ : ٤١ مجم.

عند حساب مدة الطور البالغ، كان جى زد (٤٢٥٥ - ٣ - ١) . جى زد (٤١٢٢ - ٢٣ - ٤ - ٢) هما اكثر الاصناف مقاومة مسببة طول اعمار الاطوار البالغة والتي وصلت الى ما بين ٧,٣ : ٦,٧ يوما.

وبصفة عامة ، فقد اختلفت درجة المقاومة البيولوجية كثيرا باختلاف الصنف ومرحلة النمو النباتية وكذلك الجنس فى الحشرة، وكان جيزة ١٧٦، تودوروكيواز ، كاجاهيكارى هى اعلى الاصناف والسلالات المختبرة مقاومة ، كما كانت النباتات فى مرحلة التفريع أكثر مقاومة منها فى مرحلة الإزهار.