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VARIETAL RESISTANCE : FIELD EVALUATION AND SCREENING OF CERTAIN RICE MATERIALS AGAINST THE RICE STEM BORER, CHILO AGAMEMNON BLES., AND ROLE OF SOME FACTORS IN PLANT RELATIVE RESISTANCE

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Abstract

This investigaton was carried out on forty one commercil rice varieties and promising lines to evaluate their relative resistance and select some against rice stem borer, *Chilo agamemnon* Bles., and role of some factors in this resistance. It proved that :-

- Entries; Gz 4255-3-1, Telle Hamsa, Gz 4256-7-4-7 and Gz 4122-23-4-2 were relatively highly susceptible (more prefered) to the rice stem borer infestation showing 10.9-15.2% total damage. On the other hand, entries; Todorokiwase, Gz 4071-16-2-1, Gz4294-10-2, Kagahikari and Gz 4127-2-1-3 were the most resistant (less preferred) showing 2.6-3.5% total damage.

- The behaviour of some entries differed as sowing date differed. Most entries were less infested at recommended sowing date than those at the late date.

-Rice entries may differ in their susceptibility to the infestation by the rice borer at different stages of the rice plant growth. In general, most of the tested rice entries were more resistant during the tillering stage than flowering stage.

- In most entries, the percentage of infestation was affected by the leaf area. There was a positive relationship between them.

- Entries of japonice source were less infested with the rice stem borer than indica or commercial varieties.

- In general, plant type, sowing date, growth stage, and leaf area play an effective role in the relative resistance of rice plant.

INTRODUCTION

Rice is the staple food crop of almost the entire population in Egypt, and about one million feddans are yearly grown allover the country.

Out of about forty insects found in rice field, the rice stem borer, Chilo agamemnon Bles. is one of the most serious insects on rice plant. It causes about 10% loss in grain yield annually .

Varietal resistance is one of the most important tools in integrated pest management (IPM) system that aims at depressing infestation under the economic level. Field evaluation of plant resistance is one of the three bases (field, laboratory biological and chemical evaluation) that varietal resistance is established on. Field evaluation for the relative susceptibility of rice entries through entomology program is useful to the plant breeder. It helps in selecting and producing more resistant materials that can be used in developing less susceptible and more yielding rice varieties .

This investigation aims at evaluating forty one of the currently recommended varieties for their relative resistance against the rice stem borer infestation and hence, selecting and presenting more resistant rice materials to the breeder. Selecting resistant varieties is one of the most effective and safe items in IPM system for insect control far from insecticides and their effects. In addition, it aims at studying the effect of source of plant material, size of plant leaf, sowing date and plant growth stage on the relative plant resistance .

MATERIALS AND METHODS

To evaluate the relative susceptibility of forty one different commercial rice varieties (Giza varieties) and promising lines to infestation with the rice stem borer, Chilo agamemnon Bles., two field experiments were carried out at Agric. Res. St., Sakha, Kafr El-Sheikh Governorate, during 1995 rice seaons on two different sowing dates. First experiment at the recommended date (15 May) and the second one at the late date (15 June). For each experiment, the rice seedlings were transplanted 30 days after sowing. The experimental design was complete randomized block, five lines (5 meters long) with 4 replicates for each entry. The whole experimental field received the recommended agronomic practices. Plants were exposed to natural infestation in the field, with no insecticide application.

Samples of 25 hills were randomly selected from each experimental plot to count dead hearts (60 days after transplanting) and white heads (10 days before harvest). Percentages of dead hearts and white heads were recorded separately where the different entries may differently respond to borer infestation at the different stages of plant growth. The percentage of total damage (dead heart % + white head %) was then calculated. The average of plant-leaf area for each rice entry was measured. Data were statistically analyzed.

RESULTS AND DISCUSSION

Results of the relative susceptibility of different entries to the rice stem borer, *Chilo agamemnon* Bles. infestation at two different dates are shown in Tables (1and 2) .

In Table 1, the average damage of the two dates showed that Gz 4255-3-1, T, Gz 4256-7-4-7 and Gz 4122-23-4-2 were relatively highly susceptible entries showing 2.6, 3.2, 2.1 and 1.1% dead hearts and 12.6, 11.3, 9.9 and 9.8% white heads with the highest total damage 15.2, 14.5, 12.0 and 10.9%, respectively. Entries; Torido-1, Gz 4255-6-1, IR-28, Gz4255-6-2, Gz 4255-9-1, Gz 4255-8-2, IR 25571-31-1 and Gz 4386-34-3 were relatively susceptible to the borer showing 2.0, 1.8,2.6, 2.5, 2.3, 2.9, 1.7 and 1.9% dead hearts and 6.9, 7.0, 5.9, 4.4, 4.9, 4.3, 5.5 and 5.2% white heads, with total damage 8.9, 8.8, 5.8, 7.9, 7.2, 7.2, 7.2 and 7.1%, respectively. On the other hand, Todorokiwase, Gz 4071-16-2-1, Gz 4294-10-2, Kagahikari and Gz 4117-2-1-3 were relatively highly resistant to the borer infestation, showing 0.5, 0.8, 1.0, 0.9 and 0.9% dead hearts and 2.1, 2.3, 2.2, 2.3 and 2.6% white heads with the least total damage 2.6, 3.1, 3.2, 3.2 and 3.5%, respectively. While Gz 4294-10-4, Gz 4294-9-4, Gz 4294-10-5, Zong Hoa-3, Giza 159, Giza 180, Gz 1386-s-5-4 and Gz 4120-205-2 were relatively resistant to rice stem borer infestation. Total damage of these entries ranged from 3.7 to 4.4% showing 0.6 to 2.3% dead hearts and 2.0 to 3.7% white heads. The remaining entries moderately susceptible. All tested entries gave mean of dead hearts (1.6%) and white heads (4.6%) with total damage (6.2 %). El-Rahman and Saleh (1987) found that Giza 159 rice variety was less susceptible to *Chilo agamemnon Bles.*, and Tantawi *et al.*, (1989) mentioned that Telle Hamsa variety was much more susceptible than Giza 171, as reported in this study.

The behaviour of some entries differed as sowing date differed. Percentage of

Table 1. Evaluation of rice entries against the rice stem borer *C.agamemnon* at two different sowing dates and plant growth stages .

No.	Entries	Stem borer damage at :								
		Recommend sowing date (15 May)			Late sowing date (15 June)			Average of two dates		
		DH%	WH%	Total damage %	DH%	WH%	Total damage %	DH%	WH%	Total damage %
1	Giza -171	1.2	5.8	7.0 b-g	1.2	4.0	5.2 b-g	1.2	4.9	6.1
2	Giza -172	1.6	4.7	6.3 b-g	0.8	6.0	6.8 b-g	1.2	5.4	6.6
3	Giza -175	2.1	4.1	6.2 b-g	1.8	3.1	4.9 c-g	2.0	3.6	5.6
4	Giza -176	1.4	3.6	5.0 c-g	0.4	5.7	6.1 b-g	0.9	4.7	5.6
5	Giza -181	3.0	2.0	5.0 c-g	1.6	2.0	3.6 fg	2.3	2.0	4.3
6	GZ-1368-S-5-4	2.3	3.3	5.6 c-g	1.0	2.2	3.2 fg	1.7	2.7	4.4
7	GZ-4120-205-2	1.3	2.8	4.1 d-g	1.1	3.6	4.7 d-g	1.2	3.2	4.4
8	IR-25571-31-1	1.5	4.0	5.5 c-g	1.8	7.1	8.9 bc	1.7	5.5	7.2
9	GZ-4565-S-10	1.4	4.6	6.0 b-g	0.5	2.8	3.3 fg	1.0	3.7	4.7
10	GZ-4255-6-1	1.8	7.0	8.8 a-c	1.7	7.0	8.7 bcd	1.8	7.0	8.8
11	GZ-4255-6-2	3.7	7.4	11.1 ab	1.3	3.4	4.7 d-g	2.5	5.4	7.9
12	GZ-4255-6-3	2.5	4.5	7.0 b-g	0.6	5.7	6.3 b-g	1.6	5.1	6.7
13	GZ-4255-6-4	1.3	2.6	3.9 efg	1.0	3.2	4.2 efg	1.2	2.9	4.1
14	IR -28	3.9	6.4	10.3 abc	1.3	5.3	6.6 b-g	2.6	5.9	8.5
15	GZ-3766-38-1-1	1.8	4.7	6.5 b-g	0.4	3.0	3.4 fg	1.1	3.9	5.0
16	GZ-3766-38-1-2	1.3	3.1	4.4 d-g	0.2	4.5	4.7 d-g	0.8	3.8	4.6
17	GZ-4565-S-6	1.4	4.1	5.5 c-g	1.0	8.0	9.0 b	1.2	6.1	7.3
18	GZ-4071-16-2-1	0.7	1.5	2.2 g	0.8	3.2	4.0 fg	0.8	2.3	3.1
19	GZ-4255-3-1	4.0	9.2	13.2 a	1.2	15.9	17.1 a	2.6	12.6	15.2
20	GZ-4255-8-1	3.3	4.6	7.9 b-f	1.4	3.4	4.8 b-g	2.4	4.0	6.4
21	GZ-4255-8-2	3.5	3.6	7.1 b-g	2.2	5.1	7.3 b-f	2.9	4.3	7.2
22	GZ-4255-9-1	3.3	4.5	7.8 b-f	1.3	5.3	6.6 b-g	2.3	4.9	7.2
23	GZ-4256-1-1	2.5	5.3	7.8 b-f	1.9	3.2	5.1 b-g	2.2	4.3	6.5
24	GZ-4386-34-3	1.0	4.9	5.9 b-g	2.7	5.5	8.2 b-e	1.9	5.2	7.1
25	GZ-4122-23-4-2	1.4	6.4	7.8 b-f	0.8	13.2	14.0 a	1.1	9.8	10.9
26	GZ-4127-2-1-3	1.4	1.6	3.0 fg	0.4	3.6	4.0 fg	0.9	2.6	3.5
27	GZ-4294-9-4	2.7	2.8	4.5 d-g	1.1	2.1	3.2 fg	1.9	2.0	3.9
28	GZ-4294-10-2	1.5	1.1	2.6 fg	0.4	3.8	4.2 efg	1.0	2.2	3.2
29	GZ-4294-10-4	0.6	2.6	3.2 fg	1.2	3.0	4.2 efg	0.9	2.8	3.7
30	GZ-4294-10-5	1.3	3.1	4.4 d-g	0.7	3.5	4.2 efg	1.0	3.3	4.3
31	GZ-4256-7-4-7	2.3	7.1	9.4 a-d	1.8	12.8	14.6 a	2.1	9.9	12.0
32	Kagahikari	0.9	2.8	3.7 efg	0.9	1.8	2.7 g	0.9	2.3	3.2
33	TKY-1024	0.8	4.2	5.0 c-g	2.0	3.1	5.1 b-g	1.4	3.7	5.1
34	Zhong Hoa-3	0.6	2.2	2.8 fg	0.5	5.3	5.8 b-g	0.6	3.7	4.3
35	Todorokiwase	0.7	1.9	2.6 fg	0.3	2.3	2.6 g	0.5	2.1	2.6
36	Giza-159	1.3	2.1	3.4 efg	0.8	4.3	5.1 b-g	1.1	3.2	4.3
37	Giza-180	2.3	3.1	5.4 c-g	1.8	2.1	3.9 fg	2.1	2.6	4.7
38	IR-40	3.6	2.7	6.3 b-g	1.0	2.0	3.0 g	2.3	2.4	4.7
39	Toride-1	1.3	2.1	3.4 efg	2.6	11.8	14.4 a	2.0	6.9	8.9
40	Telle Hamsa	2.5	11.1	13.6 a	3.8	11.6	15.4 a	3.2	11.3	14.5
41	Yabani-15	2.3	3.6	5.9 b-g	0.7	5.4	6.1 g	1.5	4.5	6.0
	Mean	1.9	4.1	6.0	1.2	5.1	6.3	1.6	4.6	6.2

* Values followed by a common letter are not significantly different at 5% level by DMRT.
DH = Dead hearts, WH=white hearts.

total damage of some entries (IR 40, Gz 3766-38-1-1, Gz 4255-6-2 and IR 28) was relatively higher (6.3, 6.5, 11.1 and 10.3%) when sown on 15 May (recommended date) than the same varieties when sown on 15 June (late date), (3.0, 3.4, 4.7 and 6.6%, respectively). On the other hand, Gz 4386-43-3, IR 25571-31-1, Toride 1, Gz 4122-23-4-2 and Gz 4256-7-4-7 entries which were sown on 15 May were less infested (5.9, 5.5, 3.4, 7.8 and 9.4% total damage) than when sown on 15 June (8.2, 8.9, 14.4, 14.0 and 14.6%), respectively. Other entries such as Todorokiwase, TKY 1024, GZ 4255-8-2 and GZ 4255-6-1 relatively showed equal degrees of susceptibility at both dates, where the percentages of damage were almost equal, (2.6, 5.0, 7.1 and 8.8%) at the recommended date and (2.6, 5.1, 7.3 and 8.7%) at the late one, respectively. The present observations were interpreted and affirmed by many investigators who depended on plant duration and (or) timing of insect broods in explanation of sowing date reaction. Karuppuchamy and Gopalan (1986) and Oliver *et al.* (1973) reported that rice stem borer damage in tested varieties was remarkably consistent regardless of planting dates. Richharia (1963) reported that sowing date reaction may be due to the timing of the insect broods and plant duration.

Rice entries may differ in their susceptibility to the borer infestation at the different stages of rice plant growth. In general, most of the tested rice entries were more resistant during the tillering stage than flowering stage. Percentage of dead hearted plants in TKY 1024, Giza 176, GZ 4255-6-1, GZ 4122-23-4-2, Telle Hamsa and GZ 4255-3-1 entries were lower at the tillering stage (1.4, 0.9, 1.8, 1.1, 3.2 and 2.6%) than those of white heads at flowering stage (3.7, 4.7, 7.0, 9.8, 11.3 and 12.6%), respectively, as an average of the stage in two sowing dates. Giza 180, IR 40 and Giza 181 showed almost equal degrees of susceptibility at both stages of rice plant growth. The percentages of their dead hearts were 2.1, 2.3 and 2.3% but white heads were 2.6, 2.4 and 2.0 at tillering and flowering stages, respectively. This means that resistance to the borer infestation at the tillering and flowering stages of rice plant growth was found independent of each other. Confirmative results were obtained by CRRI (1959) where some varieties were resistant at one stage but susceptible at the other, and the factors may be : the stage specificity, the structure of the sheath and stem, sclerenchymatous tissue and borer incidence at the different stages. Tiwary *et al.* (1988) indicated that some varieties were less toxic to the borer at the vegetative stage than at the reproductive stage or vice versa. Richharia (1963) mentioned that some entries were less susceptible at both the vegetative stage and the heading stage, while others were highly sus-

ceptible at both stage.

Data presented in Table 2 (as total damage %) clearly indicated that, at the recommended sowing date, japonica entries were the least infested by the borer (4.6), while hybrids (JXI) were the most infested (7.4). At the late sowing date, commercial entries (Giza vareties) were the least infested by the borer (5.0) followed by japonica (5.7), while hybrids (JXI) of (7.2) were the most infested ones. These obtained results are in line with those of Mew *et al.* (1988) who indicated that incidence of C.suppressalis was more frequent on hybrid rice than conventional varieties. As an average, infestation in tillering stage as dead heart % (1.6) was less than in flowering one as white head % (4.6), Tiwary *et al.*, (1988). Japonica entries averaged the least total damage % (5.2) followed by commercial (5.6) and indica (6.9), while hybrids were the least (7.3). Gu *et al.*, (1989) reported that japonica genotypes were generally more resistant to rice stem borer than indica ones.

Table 2. Varietal resistance to rice stem borer as affected by sowing date, growth stage and plant type.

Sowing date	Growth stage	Plant type				Average
		Japonica, J	Indica, I,	J x I	Commercial	
Recommended	Tillering stage (DH%)	1.3	2.7	2.4	2.3	1.9
	Flowering stage (WH%)	3.3	4.6	5.0	3.8	4.1
	Damage % (WH+DH)	4.6	7.3	7.4	6.1	6.0
Late	Tillering stage (DH%)	0.9	1.8	1.3	1.2	1.2
	Flowering stage (WH%)	4.8	4.6	5.9	3.8	5.1
	Damage % (WH+DH)	5.7	6.4	7.2	5.8	6.3
Average	Tillering stage (DH%)	1.1	2.3	1.9	1.8	1.6
	Flowering stage (WH%)	4.1	4.6	5.4	3.8	4.6
	Damage % (WH+DH)	5.2	6.9	7.3	5.6	6.2

DH = Dead hearts at tillering stage.
WH = White head at flowering state.

Concerning the relationship between the leaf area and the percentage of damage, results in Table (3) revealed that entries which had leaf area less than 18.6 cm2 were less infested (averaged 4.9 %) than those had leaf area more than 18.6 cm2 (averaged 7.6%). Todorokiwase entry as the least damaged (2.6%) had relatively little leaf area (13.6 cm2), while Gz 4255-3-1 entry as the most infested one (15.2 %) had relatively big leaf area (22.1 cm2). This means that the plant damage was positively affected by the plant leaf area. Bishara (1966) stated that the percentage of infestation and leaf width in different varieties were in positive

Table 3. Rice entries resistance against rice stem borer, C.agamemmon as affected by plant type and leaf area index (LAI) .

No.	Entries	Plant characters		Damage % Av. of two dates
		Type	LAI (cm2)	
1	Giza -171	J	16.6	6.1
2	Giza -172	J	19.4	6.6
3	Giza -175	IJ	14.9	5.6
4	Giza -176	J	18.6	5.6
5	Giza -181	I	25.0	4.3
6	GZ-1368-S-5-4	I	20.1	4.4
7	GZ-4120-205-2	J	11.8	4.4
8	IR-25571-31-1	I	27.3	7.2
9	GZ-4565-S-10	IJ	16.8	4.7
10	GZ-4255-6-1	IJ	24.1	8.8
11	GZ-4255-6-2	IJ	20.0	7.9
12	GZ-4255-6-3	IJ	19.5	6.7
13	GZ-4255-6-4	IJ	22.8	4.1
14	IR -28	I	23.0	8.5
15	GZ-3766-38-1-1	J	14.8	5.0
16	GZ-3766-38-1-2	J	18.5	4.6
17	GZ-4565-S-6	IJ	20.1	7.3
18	GZ-4071-16-2-1	IJ	12.4	3.1
19	GZ-4255-3-1	IJ	22.1	15.2
20	GZ-4255-8-1	IJ	19.6	6.4
21	GZ-4255-8-2	IJ	18.6	7.2
22	GZ-4255-9-1	IJ	20.6	7.2
23	GZ-4256-1-1	IJ	21.3	6.5
24	GZ-4386-34-3	J	10.6	7.1
25	GZ-4122-23-4-2	J	14.4	10.9
26	GZ-4127-2-1-3	J	21.5	3.5
27	GZ-4294-9-4	J	13.1	3.9
28	GZ-4294-10-2	J	14.2	3.2
29	GZ-4294-10-4	J	11.1	3.7
30	GZ-4294-10-5	J	12.8	4.3
31	GZ-4256-7-4-7	IJ	23.1	12.0
32	Kagahikari	J	14.6	3.2
33	TKY-1024	J	17.6	5.1
34	Zhong Hoa-3	J	16.8	4.3
35	Todorokiwase	J	13.6	2.6
36	Giza-159	J	22.6	4.3
37	Giza-180	I	18.5	4.7
38	IR-40	I	17.7	4.7
39	Toride-1	J	24.7	8.9
40	Telle Hamsa	I	25.7	14.5
41	Yabani-15	J	16.7	6.0
	Mean		18.5	6.2

J = Japonica, I = Indica, IxJ = Indica x Japonica.
LAI = Leaf area index.

regression at the same stage. Some other entries did not show this regression, IR 25571-31-1 showed relatively big leaf area (27.3 cm2) but low damage (7.2%). This may be due to the opposite effects of some morphological characters on insect damage like trichomes. El-Rahman and Saleh (1987) mentioned that trichomes were taller and more dense on non-preferred varieties than on preferred ones .

As a general conclusion, it can be reported that rice entry, sowing date, growth stage, type of plant and leaf area play an effective role in the relative resistance of rice plant .

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المقاومة الصنفية : تقييم حقلي وانتخاب لبعض أصناف وسلالات الأرز ضد ثاقبة ساق الأرز ، ودور بعض العوامل في المقاومة النسبية للنبات

علي محمود سليمان

معهد بحوث وقاية النباتات - مركز البحوث الزراعية بالجيزة .

أجريت هذه الدراسة الحقلية علي ٤١ صنفاً محلياً وسلالة أرز مبشرة لتقييم مقاومتها النسبية وانتخاب بعضها ضد ثاقبة ساق الأرز ، وقد دلت النتائج علي الأتي :-

- السلالات : جي زد (٤٢٥٥ -٣-١)، تلي همسا ، جي زد (٤٢٥٦-٧-٤-٧)، جي زد (٤١٢٢-٢٣-٤-٢) كانت اكثر قابلية للاصابة (اكثر تفضيلا) ، وتراوحت اصابتها النسبية بين ١٠,٩ الي ١٥,٢٪ بينما السلالات : تودور وكيواز ، جي زد (٤٠٧١-١٦-٢-١) ، جي زد (٤٢٩٤-١٠-٢)، كاجاهيكاري ، وجي زد (٤١٢٧-٢٠-١-٢٣) كانت أهم السلالات التي أظهرت مقاومة نسبية (أقل تفضيلا)، فقد تراوحت نسبة الاصابة بها بين ٢,٦ الي ٣,٥٪.

- اختلفت درجة الاصابة باختلاف ميعاد الزراعة ، فقد أدي الميعاد المبكر الي الحد من اصابة معظم الاصناف.

- اختلفت درجة الاصابة باختلاف مرحلة النمو النباتية، فقد كانت معظم الاصناف في مرحلة التفريع أقل اصابة منها في مرحلة الازهار.

- اختلفت درجة الاصابة باختلاف مصدر الصنف ، فقد كانت معظم السلالات اليابانية الأصل أقل اصابة من تلك الهندية أو المحلية.

- اختلفت درجة الاصابة باختلاف متوسط المساحة الورقية ، فمعظم الأصناف ذات المساحة الأكبر كانت هي الأكثر تفضيلا للأصابة بالثاقبة.

وبصفة عامة ، وجد أن الاصناف والسلالات المختبرة تختلف نسبيا في درجة مقاومتها وأن المصدر النباتي ، وميعاد الزراعة ، ومرحلة النمو ، ومتوسط المساحة الورقية هي عوامل تلعب دورا هاما في تحديد هذه الدرجة.