ASSESSMENT OF RICE YIELD LOSSES DUE TO INFESTATION WITH RICE LEAFMINER, *HYDRELLIA PROSTERNALIS* DEEMING (DIPTERA: EPHYDRIDAE)

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Abstract

The leaf-mining ephydrid fly, *Hydrellia prosternalis* Deeming, has been recently considered an important insect pest attacking rice leaves. Damaged leaves lead to low tillering, plant stunting and late maturity. To estimate losses in rice yield caused by *H. prosternalis*, sakha 101 variety was sown as a susceptible check on four plantations, 5, 15 and 25 May, and 5 June in 2000, 2001 and 2002 rice seasons. Rice plants of each nursery were transplanted in the paddy field one month later. Rice plots of each plantation was divided into two halves, one was completely protected using insecticides to avoid insect infestation while the second one was left for natural infestation.

Leaf sampling started 7-12 days after transplanting and continued weekly for about two months after transplanting, as the plants became unfavourable to rice leafminer infestation. Numbers of eggs, infested leaves and number of mines were recorded. At harvest, the rice yields in protected and unprotected plots were assessed, and compared.

Over the two seasons of study, average yield reduction due to *H. prosternalis* infestation in the unprotected plots of the first plantation (5 May) compared to the protected ones was negligible (1.48 %). Sowing rice ten days later (15 May) induced 4.20 % yield reduction due to insect pest infestation. The yield reduction reached 14.15 % in 25 May plantation, which means more rice yield reduction. The greatest and significant yield reduction was detected in the latest sown rice plots (5 June), that averaged 18.22 % yield loss.

Thus, rice sown later than mid-May is subjected to considerable damage due to heavy attacks of *H. prosternalis*. Accordingly, it could be recommended that late rice sowing should be avoided, otherwise control measures, including chemical control, may be required to manage *H. prosternalis*.

INTRODUCTION

The rice leafminer, *Hydrellia prosternalis* Deeming is one of important rice insects in Egypt. The pest lays single eggs on leafblades, and the newly hatching larvae directly penetrate the leaf epidermis feeding on the mesophyll resulting in white longitudinal mines as a typical symptom of insect infestation.

All over the world, there are conflicting reports about the negative influence of rice leafminer infestation on rice yield. Some authors suggest that the infested fields suffer from considerable yield losses (Ferino 1968, Andress 1975, IRRI 1974 & 1976) while others claim no yield reduction even when rices are severely damaged (Nurullah 1979, and Shepard et al 1990).

Resistance of rice varieties to rice leafminer is not remarkable (Heinrichs *et al* 1985 and Pantoja & Salazar 1993) which puts much emphasis on developing cultural techniques to manage this insect pest. Sherif *et al.* (1997) reported that rice sown early in May had slighter insect infestation than that sown later. They also found that permanent flooded rice plots encouraged the rice leafminer infestation.

To disclose the relationship between rice leafminer infestation and yield losses, the present investigation was carried out at the experimental farm of Rice Research & Training Center (RRTC), Sakha, Agricultural Resrarch Center for three successive rice seasons, 2000, 2001 and 2002.

MATERIALS AND METHODS

In 2000, 2001 and 2002 rice seasons, yield losses due to infestation by rice leafminer, *Hydrellia prosternalis* were investigated in rice fields sown at four successive dates, May 5, 15 & 25 and June 5 with Sakha 101 variety as a susceptible check (Anonymous 2001). Rice plants of each nursery were transplanted in the paddy field one month later in plots, each of 100 m^2. Each plot was divided into two equal areas the first area was weekly treated with profenofos (Selecron 72 EC) at a rate of 750 ml/fed 7 days after transplanting up to 40 days after transplanting to prevent the rice leafminer infestation, while the second area was left without control for getting the normal rice leafminer infestation.

Sampling started 7 to 12 days after transplanting and continued weekly till the rice leaves became stiff, and not preferred to rice leafminer infestation. In each sample, 100 leaves were taken from each part, and divided into four sub-plots (25 leaves / sub plot). The leaves were introduced into labelled paper bags and transferred to Rice Research and Training Center laboratory for examination. Numbers of eggs, infested leaves (leaves containing mines) and mines were recorded.

At harvest, rice plants in 16 m^2 (about 400 hills) were cut and sun-dried. The plants were threshed and the grain yield was weighed, and adjusted for 14 % moisture content and yield per feddan. Yields of protected and unprotected plots were statistically analyzed and compared using "t" test.

RESULTS AND DISCUSSION

Rice leafminer, *Hydrellia prosternalis* symptoms (eggs, mines and infested leaves) were counted in treated and untreated plots in the four plantations (5, 15, 25 May and 5 June) during the three successive rice seasons (2000, 2001 and 2002). Results are presented in Tables 1-13.

The first plantation:

In the first plantation (sown on 5 May), infestation with *H. prosternalis* was very low in both treated and untreated rice fields (Tables 1, 2 and 3). In 2000 season (Table 1), average number of eggs, infested leaves and mines per 100 rice leaves, were 1.43, 2.57 and 4.00 in unprotected plots, and 0.86, 0.71 and 0.71 in protected ones, respectively. Accordingly, in this early plantation rice plants had very low infestation by rice leafminer. On the other hand, rice yields in both treated and untreated plots were nearly the same. Unexpectedly, the yield in unprotected plots exceeded that in protected ones by 1.55 %, however, this increase was found insignificant (T test).

In 2001 rice season (Table 2), the infestation with *H. prosternalis* was negligible in both treated and untreated rice fields. Per 100 rice leaves, averages of eggs, infested leaves and mines were 1.70, 1.50 and 2.71 in unprotected plots, and 0.57, 0.93 and 1.43 in protected ones, respectively. Results of this early plantation agree with that of the first season. Accordingly, rice yields in both treated and untreated plots were very close .However, insignificant yield reduction (2.18 %) was recorded.

In 2002 rice season (Table 3), *H. prosternalis* infestation was also very low in both plots. The same parameters were 2.12, 2.29 and 4.12 in unprotected plots, and 0.88, 1.35 and 2.12 in protected ones, respectively. Rice yield in unprotected and protected plots were almost the same (2.75 vs. 2.77 t/fed.). Thus, yield in protected plots insignificantly exceeded that in unprotected ones by only 0.72 %.

The current results are in agreement with those of Sherif *et al.* (1997) who reported that rice sown on May 1st had the least *H. prosternalis* infestation and received the lowest number of ephydrid eggs compared to the sown later.

The second plantation:

In the second plantation (sown on 15 May), the rice leafminer infestation symptoms increased in both treated and untreated plots (Tables 4, 5 and 6), compared with the infestation recorded in the first plantation.

In 2000 rice season, per 100 rice leaves, the averages were 21.00 eggs, 23.83 infested leaves and 40.08 mines in unprotected plots, while the corresponding values in protected plots were 6.17, 11.33 and 17.25 (Table 4). Rice yield was relatively higher (4.27 t/fed.) in protected plots than that in unprotected ones (4.18 t/fed.), which constitutes 2.11 % yield increase due to insecticide application. Thus, the untreated plots were more negatively affected by *H. prosternalis* infestation.

In 2001 rice season (Table 5), the rice leafminer infestation was obviously higher than that of the 1st plantation. Criteria of infestation were 21.73 eggs, 28.64

infested leaves and 59.41 mines per 100 rice leaves in unprotected plots, while the corresponding values in the protected ones were 12.14, 7.68 and 13.45. Statistical analysis (t test) revealed no significant difference in rice yield between the protected and unprotected plots. Yield reduction percentage in the unprotected plots was 6.34 %. Despite rice yield in the second plantation (in both treated and untreated plots) was less than that in the first plantation, it was clearly observed that the untreated plots were clearly more negatively affected by the *H. prosternalis* infestation.

In 2002 season (Table 6), rice leafminer infestation increased comparable to that obtained in the first plantation. Infestation averages were 21.18 eggs, 31.41 infested leaves and 60.95 mines per 100 rice leaves in unprotected plots, while the corresponding values in protected were 11.45, 7.41 and 11.50, respectively. Rice yield in protected area was higher than that in unprotected one, 3.23 and 3.37 t/fed., respectively. So, the protected yielder than the unprotected ones by 4.15 %, however, this increase was not significant.

The Third plantation:

In the third plantation, sown on 25 May, damaged rice plants by the rice leafminer greatly exceeded those of the first and second plantations.

In 2000 rice season (Table 7), averages of eggs, infested leaves and mines per 100 rice leaves were 39.63, 46.32 and 89.05 in unprotected rice , and 36.53, 17.58 and 31.74 in the protected one, respectively. This high increase of damaged rice plants could be attributed to the high *H. prosternalis* population during the sampling extended period from 1 July to 12 September. Rice yield in the unprotected field (3.60 t / fed.) was less than that in the protected one (3.80 t / fed.) by 5.26 %. However, statistical analysis showed also that the reduction in the untreated plots was not significant.

In 2001 rice season (Table 8), averages of eggs, infested leaves and mines per 100 rice leaves were 45.40, 41.65 and 93.25 in the unprotected rice, and 32.15, 20.80 and 36.20 in the protected one, respectively. Rice yield in the unprotected field (2.97 t / fed.) was insignificantly reduced than that in the protected one (3.25 t / fed.) by 8.62 %.

In 2002 rice season (Table 9), the averages of eggs, infested leaves and mines per 100 rice leaves were 49.80, 42.40 and 99.25 in the unprotected rice, and 26.05, 19.60 and 35.20 in the protected rice, respectively. The high increase of infested rice plants could be attributed to late sowing which coincides with high *H. prosternalis* population (Sherif et al 1997). Rice yield was reduced in the unprotected field (2.05 t/fed.) comparable to that of the protected one (2.87 t/fed.) by 28.57 %. The statistical analysis showed that this yield reduction was also not significant.

The fourth plantation:

Damaged rice plants in the fourth plantation (5 June) took nearly a trend similar to that recorded in the third plantation.

In 2000 rice season (Table 10), the population of the rice leafminer was high which reflected high damage to the unprotected rice plants, 27.83 eggs, 35.83 infested leaves and 72.67 mines per 100 rice leaves. The corresponding values in the protected field were18.22, 14.94 and 23.61, respectively. The yield reduction of this plantation was the highest (22.28 %) compared with those of the first, second and third plantations. Statistical analysis revealed significant yield increase of treated rice over the untreated one.

In 2001 rice season (Table 11), population of the rice leafminer was very high which declared severe symptoms on the unprotected rice plants, 67.32 eggs, 54.32 infested leaves and 136.68 mines per 100 rice leaves, in comparable with those in the protected field, 22.84, 26.16 and 40.11. The yield reduction of this plantation due to *H. prosternalis* infestation was 9.88 %. Statistical analysis revealed no significant differences between the yield of protected and unprotected rice fields (4.25 and 3.83 t / fed., respectively).

In 2002 rice season (Table 12), the population of the insect was also very high resulting in severe damage to the unprotected rice plants, 78.06 eggs, 65.89 infested leaves and 168.17 mines per 100 rice leaves. The corresponding values in the protected plots were lower, 24.94, 28. 28 and 48.33, respectively. The yield reduction in the unprotected plots was 22.49 %. This reduction was found statistically to be significant.

In a conclusion, infestation by rice leafminer, *H. prosternalis* was particularly slight in rice sown in the first plantation, and relatively high in the second plantation. However, damage of rice plants in both third and fourth plantations was greater. It was clearly evident that rice plants were severely damaged when sown on 25 May and 5 June. The levels of damage in either plantation were in parallel with the obtained rice yield in the unprotected and protected plots (Table 13).

Yield reduction due to *H. prosternalis* infestation in the unprotected plots of the 1st plantation (5May) was negligible (1.48 %). This result is in line with that of Matteson (2000), in Vietnam, who pointed out that leaf feeding insects do not appear to cause significant yield loss despite highly visible damage under most circumstances. In the current study, the yield reduction reached 14.15 % in 25 May plantation, which means that more rice yield reduction occurred as the rice was sown later. Late rice plantations resulted in heavy *Hydrellia prosternalis* infestation. Results are in accordance with those obtained by Ferino (1968) who found that heavy *Hydrellia* spp

attacks to rice plants led to stunted plants and reduced tillering which reflected yield reduction. However, the greatest yield reduction, in the current study, was detected in the latest sown rice plots (5 June). Average yield reduction due to rice leafminer damage in the unprotected plots was 18.22 %. In general, it could be recommended that rice sown after mid-May is subject to heavy attacks with *H. prosternalis* leading to considerable losses. These attacks are effective in reducing rice yield because the insect population becomes very high by late July and early August (El-Habashy 1997, Foda *et al..,* 1997 and Sherif and Bastawisi 1997) which coincides with active tillering of late sown rice. Accordingly, it could be recommended that late rice sowing should be avoided, otherwise chemical control, against the rice leafminer, becomes required.

Reports concerning the effect of *Hydrellia* spp. on rice yield were conflicted. Some authors found that the insect infestation can reduce the rice yield, while most of others claimed no yield reduction, even when the damage seemed alarming to the growers. Viajante and Heinrichs (1986) reported that the larval feeding decreased plant height and delayed plant maturity. By contrast, Valencia and Mochida (1985) revealed that despite the damage caused by *Hydrellia* sp. was high in some cases, it did not significantly affect rice yield. Also, Shepared *et al.* (1990) obtained no yield loss even when up to 60 % of rice leaves were damaged by *Hydrellia* sp. Pantoja (1992) and Salazar *et al.* (1994) reported that the *Hydrellia wirthi* infestation did not result in significant yield reduction despite it looked alarming, and concluded that this insect is probably of little economic importance in rice plantation. Xiang *et al.* (1996) reported that the economic threshold for controlling *Hydrellia sasakii* is 4.6 eggs or 3.7 damaged tillers per hill.

Table 1. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the first plantation (5 May), season 2000

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 17	1	0	0	0	0	0
20	5	4	5	1	0	0
24	4	3	7	0	0	0
27	0	0	0	1	1	1
July, 1	0	5	9	2	2	2
4	0	2	3	2	0	0
8	0	4	4	0	2	2
Average of Infestation	1.43	2.57	4.00	0.86	0.71	0.71
Yield (t/fed.)	4.58			4.51		
Yield reduction%	-1.55 ns					

Table 2. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the first plantation (5 May), season 2001

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 20	1	0	0	0	0	0
24	2	2	4	1	0	0
27	4	3	6	0	1	2
July, 1	3	1	1	1	2	3
4	3	1	2	1	2	2
8	2	1	1	0	1	1
11	2	5	9	2	3	5
15	1	2	7	1	2	4
18	1	2	4	1	1	2
22	1	1	0	0	0	0
25	1	0	0	0	0	0
29	2	2	2	1	1	1
Aug., 1	1	1	2	0	0	0
5	0	0	0	0	0	0
Average of Infestation	1.70	1.50	2.71	0.57	0.93	1.43
Yield (t/fed.)	5.51			5.39		
Yield reduction%	2.18 ns					

Table 3. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the first plantation (5 May), season 2002

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 16	0	1	1	1	1	1
19	2	2	3	0	0	0
23	4	3	7	2	1	2
26	5	4	8	0	2	4
30	5	2	4	1	0	0
July, 3	4	2	4	1	2	2
7	3	1	2	0	2	3
10	2	5	7	3	3	6
14	2	3	7	2	3	4
17	1	4	8	1	2	3
24	2	3	6	1	1	2
28	3	3	5	0	1	2
31	2	4	6	3	5	7
Aug., 4	0	2	2	0	0	0
7	1	0	0	0	0	0
11	0	0	0	0	0	0
14	0	0	0	0	0	0
Average of Infestation	2.12	2.29	4.12	0.88	1.35	2.12
Yield (t/fed.)	2.75			2.77		
Yield reduction%	0.72 ns					

Table 4. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the second plantation (15 May), season 2000

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 24	0	0	0	0	0	0
27	2	0	0	0	0	0
July, 1	0	1	1	2	1	2
4	2	0	0	0	0	0
8	3	1	1	7	0	0
10	5	5	6	8	2	3
15	23	18	24	4	10	15
18	72	45	80	9	25	35
22	121	72	135	15	41	55
25	5	54	70	11	28	47
29	8	48	78	10	19	32
Aug. 1	11	42	86	8	10	18
Average of Infestation	21.00	23.83	40.08	6.17	11.33	17.25
Yield (t/fed.)	4.18			4.27		
Yield reduction%	2.11 ns					

Table 5. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the second plantation (15 May), season 2001

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 24	0	0	0	0	0	0
27	2	2	3	1	1	2
July, 1	3	3	5	0	2	3
4	3	4	6	2	3	4
8	5	5	8	5	3	7
11	6	4	6	6	2	4
15	18	15	22	8	5	8
18	54	41	62	10	13	23
22	89	66	102	13	21	38
25	17	42	86	9	17	34
29	44	58	106	45	12	21
Aug., 1	66	58	117	59	15	29
5	35	56	111	16	11	18
8	17	47	88	8	6	9
12	16	50	97	9	10	12
15	39	69	137	41	22	41
19	28	51	105	23	16	26
22	21	53	101	7	9	15
26	13	33	73	5	1	2
29	2	21	54	0	0	0
Sept., 2	0	8	18	0	0	0
5	0	0	0	0	0	0
Average of Infestation	21.73	28.64	59.41	12.14	7.68	13.45
Yield (t/fed.)	3.40			3.63		
Yield reduction%	6.34 ns					

Table 6. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the second plantation (15 May), season 2002

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
June, 23	0	1	2	1	1	1
26	3	2	4	0	2	3
30	3	4	7	1	2	2
July, 3	5	5	8	0	3	3
7	7	6	9	3	4	5
10	6	5	8	5	3	5
14	21	17	29	10	6	9
17	61	51	88	16	18	24
24	49	57	108	25	17	28
28	38	63	127	33	16	31
31	74	62	138	41	12	20
Aug., 4	42	58	120	25	14	23
7	23	50	91	12	11	15
11	16	48	85	10	8	11
14	46	73	150	22	17	22
18	31	60	127	20	16	28
21	28	47	89	16	8	12
25	12	36	69	10	3	6
28	1	27	45	1	1	2
Sept 1	0	16	31	1	1	3
4	0	3	6	0	0	0
8	0	0	0	0	0	0
Average of Infestation	21.18	31.41	60.95	11.45	7.41	11.50
Yield (t/fed.)	3.23			3.37		
Yield reduction%	4.15 ns					

Table 7. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the third plantation (25 May), season 2000

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July, 1	10	0	0	8	0	0
4	29	10	13	49	0	0
8	101	16	27	70	33	52
10	88	44	65	69	25	50
15	38	50	104	52	36	56
22	40	52	94	170	28	58
25	131	51	180	144	76	126
Aug. 1	124	100	246	34	30	60
5	58	80	192	40	24	62
8	110	91	219	56	22	37
16	2	42	72	0	6	10
19	12	44	102	2	10	14
22	0	44	110	0	8	8
26	4	40	82	0	14	30
29	2	28	48	0	4	4
Sept. 3	0	24	36	0	12	18
6	4	10	12	0	0	0
9	0	30	54	0	6	18
12	0	24	36	0	0	0
Average of Infestation	39.63	46.32	89.05	36.53	17.58	31.74
Yield (t/fed.)	3.60			3.80		
Yield reduction%	5.26 ns					

Table 8. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the third plantation (25 May), season 2001

Date of Examination		Per 100 Rice Leaves					
		Unprotected			Protected		
		Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July,	1	7	0	0	3	0	0
	4	25	5	9	8	1	1
	8	77	21	36	24	16	22
	11	86	33	57	41	27	49
	15	37	48	91	36	29	51
	18	34	41	75	53	27	47
	22	31	34	60	69	25	43
	25	92	78	128	89	62	106
	29	118	58	198	108	60	105
Aug.,	1	127	91	207	69	43	88
	5	52	61	166	57	24	41
	8	88	60	151	11	11	16
	12	38	49	110	16	18	27
	15	51	66	194	48	45	81
	19	17	41	87	7	17	27
	22	15	36	76	0	5	9
	26	9	35	78	2	3	7
	29	2	33	67	1	1	2
Sept.,	2	1	22	39	0	2	2
	5	1	21	36	1	0	0
Average of Infestation		45.40	41.65	93.25	32.15	20.80	36.20
Yield (t/fed.)		2.97			3.25		
Yield reduction%		8.62 ns					

Table 9. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the third plantation (25 May), season 2002

Date of Examination		Per 100 Rice Leaves					
		Unprotected			Protected		
		Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July,	3	31	6	11	10	2	2
	7	81	32	48	15	12	17
	10	98	45	74	35	33	58
	14	43	52	91	45	35	63
	17	33	39	78	27	29	60
	24	83	55	147	59	43	79
	28	133	71	215	90	57	97
	31	143	93	225	77	46	80
Aug.,	4	82	80	187	66	28	55
	7	82	61	160	37	20	37
	11	42	51	126	10	15	27
	14	75	62	182	29	30	57
	18	24	53	100	12	23	35
	21	21	42	88	3	6	13
	25	15	35	77	4	8	15
	28	4	29	61	1	3	6
Sept.,	1	1	20	47	1	2	3
	4	2	19	33	0	0	0
	8	3	3	5	0	0	0
	11	0	0	0	0	0	0
Average of Infestation		49.80	42.40	99.25	26.05	19.60	35.20
Yield (t/fed.)		2.05			2.87		
Yield reduction%		28.57 ns					

Table 10. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the fourth plantation (5 June), season 2000

Date of Examination		Per 100 Rice Leaves					
		Unprotected			Protected		
		Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July,	15	80	60	38	50	18	21
	22	88	46	112	41	16	30
	25	70	52	126	58	25	47
Aug.,	1	92	78	172	90	55	58
	5	84	72	206	58	38	62
	8	65	68	178	30	31	51
	16	12	50	110	1	22	44
	19	6	48	120	0	26	40
	22	0	24	50	0	8	12
	26	0	26	40	0	18	34
	29	2	32	22	0	6	16
Sept.,	3	0	26	30	0	2	4
	6	2	18	35	0	2	4
	9	0	14	22	0	0	0
	12	0	8	17	0	2	2
	16	0	14	20	0	0	0
	24	0	5	6	0	0	0
	30	0	4	4	0	0	0
Average of Infestation		27.83	35.83	72.67	18.22	14.94	23.61
Yield (t/fed.)		3.07			3.95		
Yield reduction%		22.28 *					

Table 11. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the fourth plantation (5 June), season 2001

Date of Examination		Per 100 Rice Leaves					
		Unprotected			Protected		
		Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July	22	78	52	100	34	22	36
	25	77	56	116	44	27	55
	29	114	87	241	76	46	73
Aug.,	1	102	95	269	63	50	81
	5	97	91	255	32	42	68
	8	59	76	197	19	31	50
	12	71	65	164	7	37	57
	15	88	63	171	13	34	44
	19	99	68	188	13	19	27
	22	102	68	197	37	24	30
	26	75	53	123	12	17	21
	29	60	55	125	9	22	36
Sept.,	2	58	49	118	18	34	51
	5	59	41	98	21	35	50
	9	61	42	87	19	22	37
	12	38	33	66	10	16	22
	16	24	21	45	6	15	17
	19	17	14	31	1	4	7
	23	0	3	6	0	0	0
Average of Infestation		67.32	54.32	136.68	22.84	26.16	40.11
Yield (t/fed.)		3.83			4.25		
Yield reduction%		9. 88 ns					

Table 12. Rice leafminer, *Hydrellia prosternalis* infestation symptoms, and rice yield of protected and unprotected rice plots in the fourth plantation (5 June), season 2002

Date of Examination	Per 100 Rice Leaves					
	Unprotected			Protected		
	Eggs	Infested Leaves	Mines	Eggs	Infested Leaves	Mines
July, 17	58	62	120	30	25	42
24	97	78	196	41	36	62
28	135	93	272	51	46	82
31	132	96	289	55	56	86
Aug., 4	105	90	268	28	39	71
7	75	81	237	27	42	66
11	74	60	153	11	31	50
14	89	64	182	12	30	55
18	91	70	185	10	21	30
21	118	84	225	50	27	48
25	91	69	172	26	20	39
28	68	72	177	15	21	42
Sept., 1	55	70	153	21	37	64
4	67	67	140	28	18	29
8	65	51	110	21	22	40
11	50	38	76	13	16	33
15	29	30	55	8	14	21
18	6	11	17	2	8	10
Average of Infestation	78.06	65.89	168.17	24.94	28 .28	48.33
Yield (t/fed.)	2.62			3.38		
Yield reduction%	22.49 *					

Table 13. % rice yield reduction of four successive plantations due to *Hydrellia prosternalis* infestation

Year	Yield reduction (%)			
	1st plantation	2nd plantation	3rd plantation	4th plantation
2000	1.53	2.11	5.26	22.28
2001	2.18	6.34	8.62	9.88
2002	0.72	4.15	28.57	22.49
Overall (Grand mean)	1.48	4.20	14.15	18.22

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الخسائر الناتجة عن الإصابة بصانعة أنفاق أوراق الأرز

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أجريت هذه التجربة خلال مواسم ٢٠٠٠ ، ٢٠٠١ ، ٢٠٠٢ . زُرع الصنف سخا ١٠١ فى أربعة مواعيد على النحو التالى : ٥ ، ١٥ ، ٢٥ مايو ، ٥ يونيو . كان الهدف من التجربة هو تقدير الخسائر الناتجة عن الإصابة بهذه الحشرة فى كل عروة على حدة . وعلى ذلك قُسمت القطع التجريبية فى كل عروة إلى قسمين متساويين عومل أحدهما بالمبيدات أسبوعياً لمنع الإصابة تماماً ، فى حين تُرك الأخر لإصابة الحشرة الطبيعية .

أظهرت الدراسة أن الفقد فى المحصول فى الميعاد الأول (٥ مايو) كان ضعيفاً جداً (١,٤٨%) ، وعلى ذلك فإن أعراض الإصابة بهذه الحشرة وبالرغم من أنها قد تبدو مقلقة فى بعض الأحيان إلا أنها لا تؤدى إلى خسائر تُذكر فى المحصول . وفى ميعاد الزراعة الثانى (١٥ مايو) وصلت نسبة الفاقد فى المحصول إلى ٤,٢٠ % ، بينما بلغت الخسائر ٤,١٥% فى الميعاد الثالث (٢٥ مايو) ، وهذا يعنى بصفة عامة أن الخسائر الناتجة عن هذه الحشرة تزداد كلما تم التأخير فى ميعاد الزراعة. وعموماً ، حدثت أكبر خسارة فى المحصول فى عروة ٥ يونيو حيث وصلت نسبة الفاقد فى المحصول إلى ١٨,٢٢ %، وأوضح التحليل الإحصائى أنها خسارة معنوية.

ولهذا يمكن القول أن الأرز المنزرع بعد منتصف مايو يتعرض لخسائر فى المحصول بالمقارنة بذلك الذى يزرع خلال النصف الأول من نفس الشهر ، حيث تتعرض المواعيد المتأخرة للإصابة الشديدة بحشرة صانعة أنفاق أوراق الأرز التى يصل تعدادها إلى ذروته فى أواخر يوليو وأوائل أغسطس . وعلى ذلك يمكن التوصية بتجنب زراعة الأرز فى مواعيد متأخرة عن النصف الأول من مايو وإلا سيتطلب ذلك إجراء مكافحة كيماوية لهذه الحشرة .