CULTURAL PRACTICES TO MANAGE THE RICE LEAF MINER, *HYDRELLIA PROSTERNALIS* (DIPTERA: EPHYDRIDAE) IN EGYPT .

M.R. SHERIF[1] , I. KHODAIR[2] AND M. EL-HABASHY[3]

1 Rice Research and Training Centre (RRTC), Sakha, Plant Protection Research Institute, Agricultural Research Centre.

2 Economic Entomology, Faculty of Agriculture, Kafr El-Sheikh, Tanta University.

3 Rice Research and Training Centre (RRTC), Sakha, Field Crops Research Institute,Agricultural Research Centre.

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Abstract

Hydrellia prosternalis Deeming, a leaf-mining ephydrid fly, has been recently considered an important insect pest attacking rice leaves. Influence of certain cultural practices on the incidence of this insect in rice fields was studied for two successive seasons; 1995 and 1996 at the experimental farm of Rice Research and Training Center (RRTC), Sakha.

Rice sown on May 1st had the least infestation (3.63 - 4.75%) and received the lowest number of eggs (1.56-1.75 / 100 rice leaves). The rice leaf miner (RLM) incidence increased gradually and significantly as the sowing date was later. Rice sown after the end of May suffered from severe RLM infestation (56.63 - 64.17 and 68.67-69.17% for 1 June and 15 June cultivations, respectively).

Permanent flooded rice plots proved to encourage the RLM incidence, having 57.50% infestation, and this level was gradually decreased as the irrigation intervals prolonged. Infestation rates were 42.50, 22.86 and 18.95% at 6,9 and 12-day intervals, respectively.

It was apparent that plant densities had no effect on RLM infestation. Plots of transplanting spacings at 10 x 10 and 10 x 15 cm were less infested by RLM than those of wider spaces; 20 x 20, 20 x 30 and 30 x 30 cm during two weeks after transplanting. When the time elapsed, no RLM infestation differences were detected due to transplanting spacing beginning from the third week after transplanting.

INTRODUCTION

The rice leaf miner, Hydrellia prosternalis Deeming has recently became an important insect pest in rice fields in Egypt, as the larvae damage the rice plants by mining their leaves.

Allover the world, there are conflicting reports about the importance of rice leaf miner, Hydrellia spp. as an economic pest of rice. Some authors suggest that it leads to considerable yield losses (Ferino, 1968; Andres, 1975; IRRI, 1974 and 1976), while others claim no reduction in yield even when rices are severly damaged (Nurullah, 1979; Viajante, 1982; Viajante and Heinrichs, 1986 and Shepard *et al.*, 1990)

Within the Integrated Pest Management, the cultural control is considered an important component, including date of sowing, water regime and plant density. Patnaik *et al* (1987) found that the infestation by H.philippina occurred 30 days after transplanting. Jaswant *et al* (1990) reported that rice varieties planted 8 July suffered less damage than those planted on 15 and 22 July. Also, Krishnaiah and Rao (1990) recommended early planting of rice in June as a cultural control to this insect.

International Rice Research Institute (IRRI) reports for 1974 and 1983 indicated that saturated rather than flooded soil reduced the rice leaf miner damage level and number of eggs. Alternate flooding and draining significantly reduced the damage caused by H.philippina (Karuppuchamy and Uthamasamy, 1984). Also, Pantoja *et al* (1993) mentioned that rice plants subjected to permanent flooding had more rice leaf miner eggs, mines and pupae per plant than those subjected to a weekly flush.

Concerning the plant spacing, Krishnaiah and Rao (1990) recommended close spacing; 10 x 10 cm in short-duration and 15 x 10 cm in medium-or long-duration rice varieties to minimize Hydrellia sp. infestation. Salazar *et al* (1993) recorded the greatest attack by H.wirthi at the lowest plant density, without affecting yields.

The present investigation was conducted in 1995 and 1996 rice seasons at the experimental farm of Rice Research and Training Center (RRTC), Sakha as a contribution to the knowledge of the relationships between rice leaf miner, H. prosternalis incidence and certain cultural practices, date of sowing, water regime and transplanting spacing.

MATERIALS AND METHODS

The effect of the following cultural practices on the rice leaf miner incidence was investigated :

1. Date of sowing

In 1995 and 1996 rice growing seasons, the highly susceptible cultivar, Giza

176 was sown on four successive dates (cultivations); May 1st and 15 th and June 1 st and 15 th. Each cultivation was transplanted one month later in six replicates (1/50 feddan each), and the normal cultural practices were adopted as recommended without chemical control. Few days after transplanting, each cultivation was sampled by 150 rice leaves (25 leaves x 6 replicates) and transferred to the laboratory for recording the numbers of infested (mined) leaves, deposited eggs and mines.

2. Water regime

This experiment was conducted in 1995 rice season. The same cultivar (Giza 176) was relatively sown late, on May 25 for maximizing the infestation, and transplanted one month later. Four treatments (water regimes) were considered, and each one was replicated in four plots (1/50 feddan/plot). The treatments are : 1) continuous flooding, 2) 6-day irrigation intervals,3) 9-day irrigation intervals, and 4) 12-day irrigation intervals. When the infestation reached its maximum, one month after transplanting (according to Foda *et al*, 1996), 400 rice plants were examined (100 plants x 4 replicates) for recording the infested leaves, deposited eggs and number of mines.

3. Transplanting spacing

Rice leaf miner incidence was tested as affected by five transplanting spacings; 10x10, 10x15, 20x20, 20x30 and 30x30 cm in 1996 rice season. Giza 176 rice cultivar was sown on 10 June and transplanted one month later, each of transplanting spacing in four replicates (1/50 feddan/plot). One week after transplanting, four samples at 7-day intervals were taken from each treatment, 400 rice plants (100 plants x 4 replicates). Rice plants were examined for number of infested (mined) leaves and number of mines.

Data obtained for the three abovementioned cultural practices were subjected to analysis of variance, and to Duncan's Multiple Range Test for comparing the means.

RESULTS AND DISCUSSION

1. Date of sowing

1995 rice season

Data presented in Table 1 show the influence of different sowing dates on rice infestation by the rice leaf miner. Statistical analysis revealed significant differences in infestation levels among the four cultivations.

The first treatment (sown on 1 May) had very slight damage; 2.42% infested (mined) leaves, and abruptly increased to 34.75% for rice sown on 15 May. However, no significant increase was detected when rice was sown two weeks later (June 1st) as the mined leaves were 37.75%. The highest level of infestation was recorded when rice was sown on 15 June (45.75 infested leaves/100 leaves). Number of deposited eggs took a trend similar to that of infested leaves. The lowest number 1.04 eggs/100 leaves) was counted for the first cultivation, and increased sharply and significantly in the second cultivation (11.92 eggs) followed by that of the third cultivation (19.92 eggs). Also, the highest number of deposited eggs (21.71per 100 rice leaves) was recorded on the plants of the fourth cultivation (15 June). Number of mines per 100 rice leaves which indicates the severity of damage by the rice leaf miner was considered. The first, second, third and fourth cultivations suffered 3.54, 59.96, 70.13 and 74.21 mines/100 rice leaves, respectively.

1996 rice season

Rice leaf miner incidence as affected by sowing dates in the second season is presented in Table 2. The lowest number of mined leaves (3.17) was detected for the early cultivation, 1 May, followed by that sown on mid-May (35.22 infested leaves/100 leaves), and both differed significantly . The infestations in the third and fourth cultivations were statistically insignificantly different, but differed numerically (42.78 and 46.11 infested leaves /100 leaves, respectively).

As for number of laid eggs, very few eggs (1.17/100 leaves) were recorded on the rice plants of the first cultivation, but increased sharply and significantly to 29.72 eggs when rice was sown on 15 May. However, the rice leaves received the highest number of eggs (69.61) in late sown rice (15 June).

Number of mines took a trend completely similar to that of deposited eggs. The plants of the first cultivation had 5.11 mines/100 leaves followed by 69.72 mines for the second cultivation, with a highly significant difference. The third and fourth cultivations differed numerically but not significantly, having 137.61 and 165.83 mines/100 rice leaves, respectively .

On the other hand, Table 1 showed that the average of infested rice leaves by the rice leaf miner was low throughout June and increased gradually by the beginning of July. This level got higher beginning from 23 July (43.0) and increased gradually to reach its maximum (99.50) on 13 August. This level was more or less high

Table 1. Rice leaf miner, Hydrellia prosternalis damage as influenced by date of sowing (RRTC, Sakha; 1995) .

Date of	No. per 150 rice leaves														
	Infested leaves					Eggs					Mines				
examination	1 May	15 May	1 Jun	15 Jun	Av.	1 May	15 May	1 Jun	15 Jun	Av.	1 May	15 May	1 Jun	15 Jun	Av.
June 4	0	-	-	-	0.00	1	-	-	-	1.00	0	-	-	-	0.00
11	6	-	-	-	6.00	5	-	-	-	5.00	8	-	-	-	8.00
18	5	0	-	-	2.50	10	2	-	-	6.00	8	0	-	-	4.00
25	11	4	-	-	7.50	3	8	-	-	5.50	17	4	-	-	10.50
July 2	8	15	0	-	7.67	0	12	1	-	4.33	7	22	0	-	9.67
9	4	45	5	-	18.00	0	33	21	-	18.00	11	150	5	-	55.33
16	2	70	18	0	22.50	1	28	23	1	13.25	2	280	34	0	79.00
23	4	76	85	7	43.00	0	47	148	23	47.00	5	220	163	7	98.75
30	5	85	119	20	57.25	3	32	104	22	40.25	5	196	315	33	137.25
Aug. 6	3	93	112	108	74.00	0	33	53	150	59.00	5	208	264	180	164.25
13	4	105	114	130	99.50	0	22	65	118	51.25	6	63	299	307	168.75
20	1	94	99	132	81.50	1	15	30	55	25.25	2	54	274	350	170.00
27	1	82	82	145	77.50	0	18	4	60	20.50	1	60	66	315	110.50
Sep. 3	1	61	86	96	61.00	1	18	14	42	18.75	4	53	68	250	93.75
10	3	53	80	118	63.50	0	15	7	17	9.75	4	55	72	86	54.25
17	0	30	51	107	47.00	0	13	5	11	7.25	0	39	49	79	41.75
24	-	13	24	76	37.67		11	2	8	7.00		17	39	71	42.33
Oct. 1	-	8	14	42	21.33		9	0	6	5.00	-	18	19	33	23.33
8	-	-	10	22	16.00			1	3	2.00	-		11	35	23.00
15	-	-	7	18	12.50			0	2	1.00	-		5	17	11.00
22	-	-	-	9	9.00			-	2	2.00	-			10	10.00
29	-	-	-	5	5.00			-	1	1.00	-		-	8	8.00
Average	3.63	52.13	56.63	68.67	-	1.56	17.88	29.88	32.56	-	5.31	89.94	105.19	111.31	-
%	2.42 a	34.75b	37.75b	45.78c	-	1.04a	11.92b	19.92bc	21.71c	-	3.54 a	59.96b	70.13bc	74.21c	-

Means followed by the same letter are not significantly different at 5% level.

by the end of August (77.50), and decreased gradually throughout September. Nearly, the same information could be detected from Table 2, as the infestation was recorded high (47.25) on 24 July, and preceded by low level during June and early July. Then, it became higher by the first week of August (73.0), and kept high throughout August. Since the rice leaf miner attacks the rice plants more severely about 30 days after transplanting (Patnaik *et al*, 1987 in India and Foda *et al*, 1966 in Egypt), it is important to sow rice early to enable the plants to avoid high damage which coincides with the high population of the insect by mid-July. The obtained results are in ageement with those of El-Metwally, (1977) and Abdallah and Bleih, (1995) in Egypt who recommended that rice should be sown on early May to be less liable to infestation by H.prosternalis. Also, a similar recommendation was emphasized by Krishnaiah and Rao in India (1990) who mentioned that early planting of rice in June reduces its infestation by rice leaf miner.

2. Water regime

Data presented in Table 3 show the effect of different water regimes on the rice leaf miner infestation to the rice plants. The permanent flooded plots suffered the highest infested (mined) leaves, 57.50% followed by plants in plots irrigated at 6-day intervals, 42.50% with no significant difference between the two treatments. When the irrigation intervals were prolonged to 9-days, a significant reduction in infestation was recorded (22.86%) followed by another reduction (18.95%) at 12-day irrigation intervals, without a significant difference between the two latter values.

Average number of deposited eggs took a similar trend. The highest value (33.18 eggs/100 rice leaves) was recorded in case of continuous flooding, followed by a significant reduction in plants irrigated at 6-day intervals (21.90 eggs), and then in plants having irrigations every 9 days (12.55). The least number of eggs (11.62) was deposited on rice plants growing in less humid conditions (12-day irrigation intervals).

The severity of rice leaf miner incidence was recorded as the number of mines/100 leaves. Again, the permanent flooded plots had the highest level of mines (150.29 mines/100 rice leaves), while the lowest value was expressed on the least humid plots, having irrigations every 12 days, as the average number of mines was 32.39. Intermediate values of mines (73.71 and 41.60/100 leaves) were recorded on rice leaves in plots irrigated every 6 and 9 days, respectively. Significant differences were calculated among the four treatments of water regimes. Annual IRRI reports for 1974 and 1983. Karuppuchamy and Uthamasamy (1984) in the Philip-

Table 2. Rice leaf miner, *Hydrellia prosternalis* damage as influenced by date of sowing (RRTC, Sakha, 1996) .

Date of examination	No. per 150 rice leaves														
	Infested leaves					Eggs					Mines				
	1 May	15 May	1 Jun	15 Jun	Av.	1 May	15 May	1 Jun	15 Jun	Av.	1 May	15 May	1 Jun	15 Jun	Av.
June 5	0				0.00	0				0.00	0				0.00
12	10				10.00	12				12.00	16				16.00
19	17	0			8.50	2	4			3.00	24	0			12.00
26	3	3			3.00	3	10			6.50	6	4			5.00
July 3	8	22	0		10.00	0	12	9		7.00	9	32	0		13.67
10	3	28	26		19.00	0	11	103		38.00	5	41	56		34.00
17	7	40	69	22	34.50	0	21	164	116	75.25	7	73	182	39	75.25
24	3	34	90	62	47.25	1	43	159	195	98.75	11	49	341	216	154.25
31	2	85	95	93	98.75	1	115	87	132	83.75	5	194	308	417	231.00
Aug. 7	2	86	104	100	73.00	0	58	167	136	90.25	4	197	406	531	284.50
14	1	116	89	96	75.00	1	94	85	156	84.00	2	242	307	470	255.25
21	1	100	102	100	75.75	1	69	80	172	80.50	3	188	322	396	227.25
28		70	70	88	76.00		50	33	90	57.67		120	150	247	172.33
Sep. 4		50	43	80	57.67		48	27	96	57.00		115	154	230	166.33
11			50	57	53.50			48	62	55.00			133	114	123.50
18			32	46	44.00			32	32	32.00			118	104	111.00
25				40	40.00				40	40.00				112	112.00
Oct. 2				36	36.00				26	26.00				109	109.00
Average	4.75	52.83	64.17	69.17	-	1.75	44.58	82.83	104.42		7.67	104.58	206.42	248.75	-
%	3.17a	35.22b	42.78bc	46.11c	-	1.17a	29.72b	55.22c	69.61c	-	5.11 a	69.72b	137.61c	165.83c	-

Means followed by the same letter are not significantly different at 5% level.

pines, and Hlfpapp (1989) in Australia and Pantoja *et al* (1993) in Colombia reported that rice plants subjected to permanent or deep flooding had more rice leaf miner eggs, mines and pupae per plant than those subjected to a weekly flush or little water cover, and found that alternate flooding and draining significantly reduced the damage by Hydrellia spp. As a conclusion, rice plants should not be permanently flooded with water, to minimize the damage by the rice leaf miner and to save the irrigation water. Accordingly, the minimum water requirements sufficient to gain the economic rice yield should be provided to rice fields.

Table 3. Rice leaf miner, *Hydrellia prosternalis* damage as influenced by water regime (RRTC, Sakha, 1995).

Irrigation intervals	Av. per 100 rice leaves		
	Infested leaves	Eggs	Mines
Permanent flooding	57.50 a	33.18 a	150.29 a
6-day	42.50 a	21.90 b	73.71 b
9-day	22.86 b	12.55 c	41.60 bc
12-day	18.95 b	11.62 c	32.39 c

Means followed by the same letter are not significantly different at 5% level.

3 Transplanting spacing

Data presented in Table 4 show the influence of five transplanting spacings on the rice leaf miner infestation in rice fields. One week after transplanting, there were significant differences among the considered spacings; the least infestations were observed at 10x10 and 10x15 on 47.0 and 50.5%, respectively. The infestation level increased to 61.0, 73.25 and 64.0% for 20x20, 20x30 and 30x30 cm, respectively. Two weeks after transplanting, little differences in infestation due to different transplanting spacings were detected; the least was for 10x15 cm having 59.75% infestation, while the damage in the remaining treatments were statistically the same. However, no significant differences were found among the tested treatments 3 or 4 weeks after transplanting, and the levels of infestation ranged between 83.75 and 86.25 in the third week, and ranged between 75.50 and 82.00 in the fourth one. Average of infestation in the five transplanting spacings, regardless of the dates of examination, revealed no significant differences.

As for average number of mines per 100 leaves, the same previous trend was found. The least numbers of mines were recorded for 10x10 and 10x15 cm (84.25 and 82.50, respectively, one week after transplanting), while the highest level (173.0 mines/100 leaves) was recorded for 20x30 cm. When the time elapsed, no significant differences were detected either 3 or 4 weeks after transplanting. Statistical analysis revealed no significant differences among the averages of the considered transplanting spacings.

However, Krishnaiah and Rao (1990) recommended the close spacing to minimize Hydrellia sp. infestation. Salazar *et al* (1993) recorded the greatest attack by H.wirthi at the lowest plant density, but without affecting yields. Thus, it could be concluded that there were some differences in infestation due to different spacings, especially at the first and second weeks after transplanting. By the third and fourth weeks, differences among different treatments have completely disappeared, which may be due to the excessive tillering of rice plants in plots with wider spacings, and thus the plant densities in different treatments became similar. But, from the point of view of rice yield, close spacing (10x15 or 20x20 cm) should be adopted to get the optimum yield.

Table 4. Rice leaf miner, *Hydrellia prosternalis* damage as affected by spacing (RRTC, Sakha, 1996).

Transplanting spacing (cm)	Weeks after tranplanting				
	1	2	3	4	Av.
	Infested leaves/100 rice leaves				
10 x 10	47.00a	68.75 b	86.25 a	77.25 a	69.81
10 x 15	50.50a	59.75 a	83.75 a	81.75 a	68.94
20 x 20	61.00b	71.25 b	84.00 a	75.50 a	72.94
20 x 30	73.25c	70.25 b	84.75 a	82.00 a	77.56
30 x 30	64.00bc	71.50 b	83.75 a	79.50 a	74.69
	Mines /100 rice leaves				
10 x 10	84.25 a	168.50 a	222.00a	177.00a	162.94
10 x 15	82.50 a	131.00 a	186.00a	197.00a	149.13
20 x 20	129.00 b	176.50ab	204.50 a	185.75a	173.94
20 x 30	173.00 c	185.75b	225.25 a	216.75a	200.19
30 x 30	126.50 b	185.50b	201.75 a	195.25 a	177.25

Means followed by the same letter are not significantly different at 5% level.

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أهمية بعض العمليات الزراعية فى مكافحة صانعة أنفاق أوراق الأرز
Hydrellia prosternalis

محمود رمزى شريف١، إبراهيم خضير٢، محمود الحبشى ٣

١ مركز البحوث والتدريب فى الأرز - سخا (معهد بحوث وقاية النباتات) - مركز البحوث الزراعية .

٢ قسم الحشرات الإقتصادية - كلية زراعة كفر الشيخ - جامعة طنطا.

٣ مركز البحوث والتدريب فى الأرز - سخا (معهد بحوث المحاصيل الحقلية) - مركز البحوث الزراعية.

أصبحت صانعة أنفاق أوراق الأرز من الآفات الحشرية الهامة التى تصيب محصول الأرز فى السنوات الأخيرة.

ولهذا أجريت عدة تجارب خلال عامى ١٩٩٥ ، ١٩٩٦ لدراسة تأثير بعض العمليات الزراعية على مكافحة هذه الحشرة. وكانت النتائج كما يلى :-

١ - عند زراعة الأرز فى أول مايو، فانه ينجو تقريبا من معظم الإصابات بهذه الحشرة (٢,٤٢ - ٣,١٧٪)، وتزداد الإصابة بتأخير الزراعة إلى أول أو منتصف يونيو ، حيث تتعرض هذه الحقول المتأخرة الى اصابات شديدة (٣٧,٧٥ - ٤٦,١١٪). وذلك لان تعداد الحشرة يزداد بشكل ملحوظ إبتداءا من الثلث الاخير من شهر يوليو، وطوال شهر أغسطس.

٢ - تزداد الإصابة فى القطع التجريبية دائمة الغمر (٥٧,٥٠٪) ولكنها تقل تدريجيا إذا أستبدل الغمر بالرى كل ٦ أو ٩ أو ١٢ يوما، حيث كانت الإصابات ٤٢,٥٠ ، ٢٢,٨٦ ، ١٨,٩٥٪ على التوالى. ويمكن تفسير ذلك على أساس أن نشاط الحشرة يزداد كلما إرتفعت نسبة الرطوبة . وعلى هذا يفضل إستبدال الغمر المستمر، بالرى على فترات ، مع إختيار أنسب الفترات التى لا توثر على المحصول إقتصاديا.

٣ - عند شتل الأرز على مسافات ضيقة (١٠ x ١٠ أو ١٠ x ١٥ سم) تقل الإصابة بتلك الحشرة، بالمقارنة بالمسافات ٢٠ x ٣٠ أو ٣٠ x ٣٠ سم، ولكن الفروق تظهر فقط بعد الشتل حتى حوالى أسبوعين ، ثم تختفى بعد ذلك عندما تزداد كثافة التفريع. وعلى هذا فإنه يمكن القول إن مسافات الشتل لا تؤثر على الإصابة بتلك الحشرة ، عندما تصل النباتات إلى فترة التفريع القصوى.