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Summary

Ecological and biological studies were carried out at the experimental farm and Entomology laboratory of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during four successive rice seasons; 2000, 2001, 2002 and 2003.

The conducted experiments and main results could be summarized as follows:

1. Assessment of rice yield losses:

1.1. Losses due to rice leafminer, *Hydrellia prosternalis*:

This experiment was carried out during 2000, 2001 and 2002 rice seasons. Rice was sown on four dates; 5, 15 and 25 May, and 5 June. The objective was to find out the losses caused by *H. prosternalis* in each cultivation. Rice plots of each cultivation was divided into two halves; one was completely protected using insecticides while the second half was left for natural infestation.

Over the three seasons of study, average yield reduction due to *H. prosternalis* infestation in the unprotected plots of 5 May cultivation was negligible (0.45 %). Thus, symptoms of leafminer damage, despite alarming in some cases, don't result in yield reduction. Sowing rice ten days later (on 15 May) induced 4.2 % yield reduction due to *H. prosternalis* infestation in the untreated plots. This level of yield reduction reached 14.15 % in 25 May cultivation, which means more rice yield reduction as the rice was sown later. However, the greatest yield reduction, in the current study, was detected in the latest sown rice plots (on 5 June). The yield reduction due to rice leafminer damage in the unprotected plots averaged 18.22 %.

Thus, rice sown after mid-May is subject to considerable losses due to heavy attacks of *H. prosternalis*. These attacks are effective in reducing rice yield because the insect population gets higher by late July and early August which corresponds with active tillering in case of late sown rice. Accordingly, it could be recommended that late rice sowing should be avoided, otherwise the chemical control of the rice leafminer, *Hydrellia prosternalis* becomes required.

1.2. Losses due to rice stem borer, *Chilo agamemnon*:

This investigation was undertaken in three successive rice seasons; 2000, 2001 and 2002 to find out the relationship between rice yield and each of dead hearts and white heads.

1.2.1. Gradual concentrations of insecticides to induce different levels of dead hearts and white heads:

Gradual concentrations of insecticides were applied to induce different levels of dead hearts and white heads. The following doses of curacron (Selecron 72 EC) were used: 200, 400, 600, 800, 1000 and 1200 ml/ fed. The insecticide was applied twice; 30 days after transplanting to induce different levels of dead hearts, and at flowering to induce different levels of white heads.

It was found that dead hearts were too little to reduce the rice yield. Thus, white heads are only responsible for reducing rice yield. In 2000 rice season, 11.79 % reduction in white heads raised the obtained yield by 10.36 %. The highest increase in yield (20.47 %) was detected when 72.46 % of white heads were removed, this was accomplished using 800 ml insecticide / fed.

Similar trends were obtained during 2001 and 2002. Considerable increase in rice yield was obtained in 2001 (12.60 %) at 800 ml curacrun / fed. that eliminated 61.45 % of white heads. In 2002, 14.77 % yield increase was obtained at 600 ml insecticide that reduced 44.23 % of white heads. However, to minimize insecticide applications in rice fields and meanwhile to obtain satisfactory rice yield, it is recommended to use only 600 ml curacron / fed., if the rice variety was susceptible to *C. agamemnon*. In all cases, it was found that dead hearts could be negligible, and farmers should not be worried about such symptom.

1.2.2. Tagging rice plants having different levels white heads:

This experiment was carried out during 2000 and 2001 rice seasons. Individual rice hills of natural infestation by *C. agamemnon* were tagged to find out the relationship between occurring white heads and obtained yield of a single hill.

Data obtained in both seasons indicated that white heads at 4-8 % were not significant in reducing rice yield compared to the rice stem borer-free hills. In the current investigation, 4-8 % means 1-2 white heads per hill (25 tillers each). Thus, the rice growers could be recommended not to be worried about rice stem borer infestation if reaches up to 2 white heads per hill. Really, it is not common to find, in a certain area of Egypt that plants have 3 or more white heads per hill allthroughout the field. Thus, insecticide application should be rationalized to be used only when the white heads exceed 8 %.

2. Rice infestation by rice leafminer, *Hydrellia prosternalis* as influced by:

2.1. Chemical components of rice leaves:

The relationships between some chemical components (silica, nitrogen, potassium and phosphorus) and damage caused by *H. prosternalis* were studied.

The high values of mines per 100 rice leaves; 417 – 430 were detected in rice varieties having low silica contents; 3.8 – 4.3 %. By contrast, entries suffering low numbers of mines (153 – 170 mines / 100 rice leaves) had the highest silica content; 4.9 – 5.7 %.

Nitrogen content of rice leaves had also negative effects on *H. prosternalis* damage. Mines and infested leaves proved to be negatively correlated with nitrogen % with " r " values of – 0.425 and – 0.614*, respectively. In the current study, potassium negatively correlated with the number of mines / 100 rice leaves (r = - 0.248) and with percentage of infested leaves (r = - 0.268). By contrast, phosphorus content positively correlated with both infested leaves (r = 0.276) and mines (r = 0.318), however, both correlation coefficients were not significant.

2.2. Chlorophyll content of rice leaves:

The relationship between number of *H. prosternalis* laid eggs and chlorophyll content of 15 rice entries was investigated in 2001 rice season. This test was conducted to find out if the chlorophyll density in rice leaves can affect the attractiveness of *H. prosternalis* flies for egg-laying.

The highest chlorophyll contents (39.00 – 44.30 ppm) were detected in some entries. Meanwhile, these entries received the highest numbers of eggs (30 – 47 eggs per 100 rice leaves). In the same trend, rice entries exhibiting low chlorophyll content, also harboured low numbers of laid eggs (7 – 14 eggs / 100 rice leaves). Thus, it could be reported that the higher chlorophyll content of rice leaves, the greater numbers of *H. prosternalis* eggs were laid.

3. Relationship between level of damaged rice plants by *H. prosternalis* and number of formed pupae, and pupal weight:

This test was conducted to investigate if there is a relationship between the level of damaged rice leaves by *H. prosternalis* and number of resulting pupae, and pupal weight. The test included 15 rice entries.

The entries exhibiting high levels of insect damage; 62 and 90 % infestation produced the greatest number of pupae; 151 and 197 individuals / 100 rice hills, respectively, as well as the heaviest pupae. By contrast, entries suffered slight *H. prosternalis* infestation, 14, and 27 %, gave low numbers of pupae; 11 and 3 / 100 rice hills, respectively, and these pupae were of low weight. This indicates that the antibiotic effect acts as a mechanism of resistance to this leafminer. These antibiotics can retard insect feeding, result in low insect populations, and consequently induce low level of damage.

4. Parasitoids of some rice insects:

4.1. *Opius hedquisti* on *Hydrellia prosternalis* larvae:

Specimens of a primary parasitoid that emerged from *Hydrellia prosternalis* pupae were collected and kept for identification. The tentative identification revealed that the specimen was for *Opius* sp. For further identification, the specimen was sent to the Systematic Laboratory of International Rice Research Institute (IRRI), the Philippines. By the aid of Dr. Alberto Barrion, the parasitoid was identified as *Opius hedquisti*.

4.2. Population fluctuation of *Opius hedquisti*:

The parasitism status of *Opius hedquisti* was investigated in 2000, 2001 and 2002 rice seasons.

The current study clearly showed that this braconid parasitoid was active allthroughout rice season, particularly by late July, and during August. This fact should put limits on the application of pesticides, particularly insecticides, on rice plants. To conserve this valuable natural enemy, rice leafminer should be managed by different means, except insecticides. Since only late rice cultivations are subject to high rice leafminer attacks, the insecticidal applications should be allowed only in such cultivations.

4.3. *Opius* morphometrics:

Detailed morphometric measurements were conducted as a basic study. The measurements included all body parts of the braconid parasitoid.

4.4. Biological studies of *Opius hedquisti* :

Larvae and pupae of *H. prosternalis* were dissected and precisely examined to detect the stages of *O. hedquisti* inside. The second larval instar of the parasitoid was detected in the full-grown larvae of *H. prosternalis*. The third and fourth larval instars of the parasitoid were excluded from the host puparium. Some specimens of *H. prosternalis* pupae included *O. hedquisti* in addition to some immatures of the parasitoid *Tetrastichus* sp.

4.5. Parasitoids of leafhoppers and planthoppers:

Population fluctuations of two egg-parasitoids, *Anagrus* sp. and *Gonatocerus* sp. were studied. Number of *Anagrus* spp. peaked on 23 May (10 indiv. / 5 water pan traps), and another peak (9 indiv.) occurred on 12 June, which coincided with a peak of hoppers. Population of *Anagrus* spp. exhibited a peak of 17 individuals that came only three days later than the peak of hoppers. The highest peak of this egg parasitoid was detected on 27 August (56 indiv.)which was one week later than the highest peak of hoppers.

The second egg parasitoid, *Gonatocerus* spp was trapped, in the water pans, in few numbers allthroughout the rice season. However, relatively high numbers of the parasitoid were obtained during the second week of June.

5. Biological aspects of rice stem borer, *Chilo agamemnon:*

5.1. Life cycle:

The rice stem borer, *Chilo agamemnon* was laboratory reared at 28 $\pm$ 1 °C and 75 $\pm$ 5 % R.H. Egg-masses were incubated for 3-5 days with an average of 4.1 days. Both larval and pupal stages lasted for 15-20 days (av.17.31) and for 4-6 days (av. 5.13), respectively. The adult longevity was 2-5 days (av. 3.5) for females, and 2-4 days (av. 3.2) for males.

5.2. Biological parameters of *Chilo agamemnon* reared on different rice varieties:

Results showed that the greatest mumber of eggs were collected from Egyptian Yasmin, Giza 178, Giza 175; 256 eggs (9 egg-masses), 220 eggs

(9 egg-masses) and 197 eggs (8 egg-masses), respectively. On the other hand, the least numbers of eggs were collected from Sakha 101 (115 eggs), IR 66160-5-2-3-2-2 (128 eggs) and Giza 176 (140 eggs).

The heaviest larval weights were obtained when the insect was reared on Egyptian Yasmin (45.60 mg), IR69138-13-2-2-3 (43.50 mg) and super 13 (40.60 mg). In the same trend, these three varieties produced the heaviest pupal weights; 28.80, 27.50 and 27.40 mg / pupa, respectively. By contrast, Giza 176, Sakha 104 and Sakha 101 produced the least larval and pupal weights; 35.90 & 20.10, 35.20 & 20.10 and 33.60 & 19.60 mg / pupa, respectively. The heaviest larval and pupal weights were obtaned when *C. agamemnon* was reared on indica rices (Egyptian Yasmin, IR69138-13-2-2-3, IR 66160-5-2-3-2-2, Giza 178 and Giza 175), while the lightest ones were obtained in japonica rices (Giza 176, Sakha 104 and Sakha 101).