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# Rice skipper, *Pelopidas thrax* (hubner) (Hesperiidae: lepidoptera): An emerging insect pest in rice fields in Egypt, host plants, population fluctuation, damage and related natural enemies

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## Abstract
Rice (*Oryza sativa* L.) is a very important food crop in Egypt, particularly with shortage of wheat production for consumers. Insect pests are one of challenges against high yield productivity. Experiments and observations conducted at rice fields at Sakha Agricultural Research Station, Egypt during 2019,2020 and 2021 seasons revealed occurrence of an emerging insect pest; rice skipper, *Pelopidas thrax* (Hubner) (Hesperiidae : Lepidoptera) . Larvae of skipper fed upon leaves of rice, barnyardgrass and juncle rice. Adult activity was low in June - July, increased by mid-August, and maximum by late August, and throughout September, with 3-4 seasonal peaks. In general, the damage in rice plants was low, so, the simulation technique, based upon removing certain areas of the flag leaves, was adapted. The treatments (removed areas); 0, 25, 50, 75 and 100 %. Induced reductions of 4.47-23.05% filled grain percentage, 2.07-6.61% in 1000-grain weight, and 5.95-31.86% in grain yield respectively. Seven parasitoid species were recorded. They are *Trichogramma evanescens* (on skipper eggs), *Telenomus* sp. (eggs), *Chelonus* sp. (egg-larva), *Anomalon* sp. (larvae), *Cotesia ruficrus* (lavae), *Brachymeria* sp. (pupae), and *Exorista* sp. (larvae). Also, two insect predators were found associated with *P. thrax*; *Anatrichus pygmaeus, Paederus alfierii* as well as the spider, *Argiope trifasciata*. Till now, *Pelopidas thrax* (Hubner) is considered a minor pest. Because of expected climatic changes and disturbances in rice ecosystem due to excessive use of pesticides, this skipper may become a major insect pest. Further studies are required to reveal additional biological and ecological aspects of this emerging insect.

**Keywords:** Rice, Egypt, skipper, host plants, population fluctuation, damage, parasitoids, predators

## Introduction
Rice is a very important food crop in Egypt, particularly with the shortage in wheat supplies. Because it plays a vital role in ensuring the food security, serious efforts are required to face the expected increasing demand of rice in the near future, because of overpopulation.
Unfortunately, biotic and abiotic stresses negatively influence the rice productivity. Insect pests are one of the biotic stresses, and it is important to monitor the appearance of new insect pests, especially with climatic changes.
Recently, it has been observed the so-called skippers infest rice fields. These insects were identified, according to the Systematic Laboratory, Plant Protection Research Institute in Egypt as *Borbo borbonica* (Boisduval) [19] and *Pelopidas thrax* (Hubner) [8].
[13, 14] concluded that *P. thrax* has been more acclimatized to arid locations of Oman Sultanate than to wet locations. In the same direction [3], confirmed the presence of *P. thrax* in Greece, where this skipper was found in hot and dry grassy places.
[20]. Surveyed various plant species of family Poaceae serving as host plants of *P. thrax* butterfly, but the host plant preferred to larvae was not identified. In Cyprus, *P. thrax* has been observed ovipositing on smilograss, *Oryzopsis miliaceae* (Poaceae) [16], with two generations a year [3]. The *P. thrax* adults were found occurring from April to November, and overwinter as larvae, forming 2-3 generations a year [2]. They added that the insect pest is widespread, as it was found in United Arab Emirates, sub-Saharan Africa, Cyprus, Egypt and Pakistan.

The skipper larvae feed upon rice leaves, removing portions of leaf tissues, and making rolled leaves near larval maturity (mature larva is about 50 mm long ) to build a protected chamber, surrounded by silken threads, to pupate inside. The adults are diurnal, while the larvae are nocturnal [18].

In a study on another species of rice skipper, [9] investigated the effect of artificial infestation of rice plants by *P. mathias* larvae. Dry matter weight decreased with increasing larval density, but the total digestible nutrients were not significantly reduced. Thus, the author concluded that this skipper may cause quantitative, not qualitative damage.

As a minor pest, *P. thrax* should not be controlled using insecticides, to avoid its turn into a major one. [12] Recommended not to use insecticides in rice fields to give the natural enemies the opportunity to regulate insect pests. A biological control program was initiated in Hawaii to readicate *P. thrax* [17]. The introduction of *Apanteles erionolae* Wilkinson, *Trichogramma* sp. and *Brachymeria obscurata* (Walker) proved to be successful, as they established against *P. Thrax*. Correlation between population densities of *Pelopidas* (= *Erionata*) *thrax* and the numbers of parasitized insects showed strong positive values [10]. There was an evidence of a delayed density dependence of the parasitoids and most peaks of parasitism that appeared 1-2 months after those of the host range [3]. Some biological agents performed well against the rice skipper, *P. mathias*, and in the same trend could be tested against the skipper, *P. thrax*. Included in some other insect pests, *P. mathias* was one of stomach contents of the frogs living in rice fields [11].

The natural balance is a very important topic in any ecosystem [7]. Accordingly, the populations of rice skipper, *Pelopidas mathias* were very low in unsprayed (balanced) rice fields, but were delected in relatively highers in sprayed (unbalanced) ones [12]. *Apanteles Javensis* Rohwer and *Cotesia erionotae* (Willkinson) were bred from parasitized larvae of *P. mathias* [1].

Away from insecticide applications, neem (*Azadirachta indica* L.) seed kernel extract was sprayed in insect-infested rice fields. Activity of chewing insects, including *P. mathias* was reduced [6]. Similarly, [18] used neem extracts and insecticides against *P. mathias*, and found that the botanical insecticides were efficient, despite the insecticide, chlorpyriphos was more effective. Till now, *P. thrax* is considered a minor insect pest, however, it may become more active in rice fields, due to excessive use of pesticides, as well as to climatic changes.

Because of the low population of *P. thrax* in natural conditions, the insect damage was simulated by removal different portions of the rice leaves. Effects of these removal levels of flag leaf, on rice yield and percentages of filled and unfilled grains, were investigated. As well as, the population fluctuations of this insect, and related parasitoids and predators were surveyed.

## Materials and Methods

This investigation was carried at the experimental farm of Rice Research and Training Center (RRTC), Sakha, Agricultural Research Station, Kafr El Sheikh Governorate, Egypt, during 2020 and 2021 rice growing seasons.

The objective was to assess the effect of infestation of rice flag leaf with the rice skipper, *Pelopidas thrax* (Hubner). Because the infestation of the insect is low, in normal cases, the damage of the insect was simulated by removal portions of the rice flag leaf to predict the impact of insect damage on rice yield and yield components, if the insect infestation becomes higher in some circumstances.

Ten rice genotypes (two released cultivars, as well as eight promising lines) (Table 1) were the target of the study. The seeds were obtained from RRTC store.

**Table 1:** Evaluated rice entries and their type

| No. | Rice Entry | Type |
|---|---|---|
| 1 | Giza 177 | Japonica |
| 2 | Giza 178 | Indica x Japonica |
| 3 | GZ10590-1-3-3-2 | Indica x Japonica |
| 4 | GZ11180-6-7-3 | Japonica |
| 5 | GZ11332-2-2-2 | Japonica |
| 6 | GZ11190-3-13-4-2 | Indica x Japonica |
| 7 | GZ11456-2-1-1-2 | Japonica |
| 8 | GZ11332-2-2-5-3 | Japonica |
| 9 | GZ11176-2-6-3-3 | Japonica |
| 10 | GZ11236-2-6-5-2 | Japonica |

### Nursery preparation

The nursery bed was ploughed three times, with addition of super potassium phosphate ($P_2O_5$) at the rate of 100 kg /fed just before the third plough. In addition, nitrogen fertilizer (46.5% urea) was added after dry leveling, and later 15 days after flooding at 100 kg N /fed, in two equal splits.

### Permanent land preparation

The permanent field was ploughed three times, with applying superphosphate potassium at the rate of 100 g/fed just before the third plough. In addition, nitrogen fertilizer in the form of urea was applied at the rate of 69 kg N /fed, in three equal splits; 1/3 before flooding, 1/3 20 days after transplanting and 1/3 40 days after transplanting.

### Nursery Sowing

The considered rice entries (Table 1) were used at the rate of 40 kg/fed. The seeds were soaked on the first of June in water for 24 hours, and incubated for additional 24 hours. The germinated seeds were sown after nursery flooding. The seedlings were moved to transplanting.

The seedlings were pulled out, and transferred to the permanent field 25 days after rice sowing, and transplanted as single plants at spaces of 20×20 cm. The experimental plot measured 16 m$^2$, with three replicates.

### Rice skipper

Using 50 double strokes and five water pan traps to catch the rice skipper adults.

### Treatments

Just before heading, 15 hills (equal in tiller number) from each entry were selected as effective tillers (panicle bearing) to receive the treatment of simulated damage.

### Damage simulation was achieved as follows:

1) Control (without leaf removal)
2) Removal of 25% of flag leaf area
3) Removal of 50% of flag leaf area
4) Removal of 75% of flag leaf area
5) Complete removal of the flag leaf

Throughout the rice growing seasons, all recommended cultural practices were applied.

**Data Recorded**

- Rice grain yield/hill, and adjusted as grams/$m^2$ at complete maturity, the damage - simulated hills were cut separately, and kept in paper bags, for during, and then the seeds were separated by hand from rice straw.
- One – hundred rice seeds were counted, and weighed to obtain 1000 - seed weight.
- Percentage of filled grains. From each replicate, twenty grams of seeds were taken, and examined for filled and unfilled grains. Thus, the percentage of filled grains was calculated.

**Statistical Analysis**

Data were subjected to ANOVA and any significant differences among means were compared according to [5].

**Results and Discussion**

**Population fluctuation of skipper adults**

Data presented in Table (2) show the population fluctuation of *Pelopidas thrax* (Hubner) adults during 2019, 2020 and 2021 rice seasons at the experimental farm of Sakha Agricultural Research Station.

The activity of *P. thrax* adults was quite low during May, and slightly increased in June. The skipper was more occurring in July and August, and exhibited the highest flight activity in September. Using 50 double strokes and five water pan traps to catch the rice skipper adults, 3-4 peaks of adult flight activity were recorded. In 2019 season, the peaks were recorded on 18th June (29), 24th July (36) and 16th September (61). In 2020 season, the flight activity peaks were recorded on 10th June (34), 8th July (37), 18th August (53), and 23rd September (68 adults). The corresponding peaks in 2021 occurred on 22nd June (40), 24th July (45), 2nd September (59 adults) and 23rd September (61).

**Parasitoids and predators related to rice skipper**

Natural enemies listed in Table (3) show that ten species were surveyed; seven parasitoids (six Hymenoptera and one Diptera), three parasitoids parasitized egg skipper, three parasitized larvae, and only one parasitoid species attacked skipper pupae. As for insect predators; one chloropid preyed upon skipper larvae, and one staphylinid preyed upon eggs. Only one spider (Araneae) trapped the skipper adults in the webs and fed upon them.

The occurrence of natural enemies covered the period from July to September in three seasons (2019, 2020 and 2021) of survey, however, the duration from July to August was that of highest skipper activity.

**Table 2:** Population fluctuation of skipper, *Pelopidas thrax* (Hubner) in rice fields, Sakha Agricultural Research Station

| Sampling date | No. Skipper adults/ 50 double strokests + 5 water pan traps | | |
|---|---|---|---|
| | **2019** | **2020** | **2021** |
| 21 May | 0 | 0 | 0 |
| 25 | 0 | 0 | 0 |
| 29 | 0 | 4 | 0 |
| 2 June | 2 | 9 | 9 |
| 6 | 6 | 10 | 9 |
| 10 | 10 | 34 | 13 |
| 14 | 12 | 19 | 16 |
| 18 | 29 | 13 | 32 |
| 22 | 8 | 11 | 40 |
| 30 | 5 | 8 | 9 |
| 8 July | 16 | 37 | 19 |
| 16 | 25 | 20 | 29 |
| 24 | 36 | 20 | 45 |
| 2 August | 34 | 19 | 23 |
| 10 | 20 | 22 | 26 |
| 18 | 43 | 53 | 31 |
| 26 | 48 | 27 | 45 |
| 2 September | 56 | 33 | 59 |
| 10 | 60 | 21 | 47 |
| 16 | 61 | 60 | 50 |
| 23 | 57 | 68 | 16 |
| Mean ± SE | 25.14±4.76 | 23.24±4.09 | 24.67±3.89 |

**Table 3:** Parasitoids and predators related to rice skipper in rice fields, 2019-2021 seasons, Sakha Agricultural Research Station

| Order | Family | Species | Stage attacked | Duration occurrence |
|---|---|---|---|---|
| | | **Parasitoids** | | |
| Hymenoptera | Trichogrammatidae | *Trichogramma evanescens* Westwood | Egg | July- August |
| | Platygastridae | *Telenomus* sp. | Egg | July- August |
| | Braconidae | *Chelonus* sp. | Egg-Larva | July- August |
| | Ichneumonidae | *Anomalon* sp. | Larvae | July- August |
| | Braconidae | *Cotesia ruficrus* (Haliday) | larvae | July-September |
| | Chalcididae | *Brachymeria* sp. | Pupa | September |
| Diptera | Tachinidae | *Exorista* sp | Larvae | September |
| | | **Predators** | | |
| Diptera | Chloropidae | *Anatrichus pygmaeus* Lamb | Larvae | August-September |
| Coleoptera | Staphylinidae | *Paederus alfierii* Koch | Egg | July-August |
| Araneae (spider) | Araneidae | *Argiope trifasciata* (Forskal) | Adult | July-August |

### Yield and yield attributes of rice genotypes

Data presented in Table (4) show that the ten evaluated rice genotypes significantly differed in percentages of field grains, with the lowest value (50.42%) in the genotype Gz11332-2-2-5-3 and greatest values; 80.72 and 82.53% in the commercial cultivars; Giza 178 and 177, respectively.

The values of 1000-grain weight exhibited highly significant values among the evaluated genotypes ranging between 1.96 g (Gz 11190-3-13-4-2) and 2.43 g (Giza 178). As for the grain yield/ $m^2$, Giza 178 was the superior cultivar (1074.3 g/$m^2$), followed by Gz 11456-2-1-1-2 (1071.9 g/$m^2$), while the lowest grain yield was attained by Giza 177 cultivar (671.5 g /$m^2$). The grain yield differed among the evaluated genotypes with hight significant differences.

**Table 4:** Yield and yield attributes of evaluated rice genotypes, at the experimental farm of Sakha Agricultural Research Station, 2020 and 2021 seasons

| Genotype | Filled grain % | 1000-grain weight | grain yield / $m^2$ |
|---|---|---|---|
| Giza 178 | 80.72 b | 2.43 c | 1074.3 a |
| Giza 177 | 82.53 a | 2.40 cd | 671.5 f |
| GZ10590-1-3-3-2 | 66.22 d | 2.18 f | 743.4 e |
| GZ11180-6-7-3 | 66.51 d | 2.71 a | 748.5 e |
| GZ11332-2-2-2 | 57.00 g | 2.21 f | 897.3 b |
| GZ11190-3-13-4-2 | 63.70 e | 1.96 g | 843.7 cd |
| GZ11456-2-1-1-2 | 72.01 c | 2.37 d | 1071.9 a |
| GZ11332-2-2-5-3 | 50.42 h | 2.21 f | 879.7 bc |
| GZ11176-2-6-3-3 | 61.53 f | 2.27 e | 824.0 d |
| GZ11236-2-6-5-2 | 57.30 g | 2.65 b | 839.43 cd |
| F test | ** | ** | ** |
| LSD = 0.05% | 1.31 | 0.051 | 52.73 |

In a column, means followed by the same letters are not significantly different at the 0.05 probability

### Effect of simulated damage (by flag leaf removal) on percentage of filled grains

Data presented in Table (5) show that the percentages of rice filled grains were negatively and significantly affected by the portions removed from of flag leaf. The reductions were highest in the entry Gz11332-2-5-3 that suffered 18.18, 30.65, 40.25 and 41.20% reductions in filled grains due to 25, 50, 75 and 100 leaf flag removal, respectively. This entry was followes by Gz10590-1-3-3-2. However, both commercial cultivars; Giza178 and Giza 177 were, in most cases, less affected by flag leaf removal as compared with other genotypes.

**Table 5:** Reduction in filled grain percentages due to flag leaf removal, at the experimental farm of Sakha Agricultural Research Station, average of 2020 and 2021 seasons

| Genotype | Flag leaf removal % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control (without) | 25 | | 50 | | 75 | | 100 | |
| | | % | Reduction % | % | Reduction % | % | Reduction % | % | Reduction % |
| Giza 178 | 88.52 a | 81.03 c | 8.46 | 79.55 cd | 10.13 | 78.70 cd | 11.09 | 75.80 e | 14.37 |
| Giza 177 | 85.80 b | 85.00 b | 0.93 | 84.40 b | 1.63 | 80.70 c | 5.94 | 76.70 de | 10.61 |
| GZ10590-1-3-3-2 | 77.33 de | 75.21 ef | 2.74 | 63.50 l-o | 17.88 | 64.50 l-n | 16.59 | 50.63 t | 34.53 |
| GZ11180-6-7-3 | 73.10 f | 70.44 gh | 3.64 | 68.85 hi | 5.81 | 59.31 pq | 18.86 | 60.90 o-q | 16.69 |
| GZ11332-2-2-2 | 64.51 lm | 66.41 i-l | -2.95 | 58.78 q | 8.88 | 52.61 st | 18.44 | 42.59 v | 33.98 |
| GZ11190-3-13-4-2 | 69.00 hi | 69.3 h | -0.43 | 66.12 j-l | 4.17 | 59.61 pq | 13.61 | 54.41 rs | 21.14 |
| GZ11456-2-1-1-2 | 81.32c | 75.64 e | 6.98 | 72.66 fg | 10.65 | 64.81 lm | 20.30 | 65.62 k-m | 19.31 |
| GZ11332-2-2-5-3 | 68.20 h-k | 55.80 r | 18.18 | 47.30 u | 30.65 | 40.75 v | 40.25 | 40.10 v | 41.20 |
| GZ11176-2-6-3-3 | 64.10 l-m | 64.30 l-n | -0.31 | 61.70 n-p | 3.74 | 62.90 m-o | 1.87 | 54.77 rs | 14.56 |
| GZ11236-2-6-5-2 | 68.45 hi | 64.10 l-n | 6.36 | 59.55 pq | 13.00 | 46.30 u | 32.36 | 48.04 u | 29.82 |
| LSD = 0.05% | 2.45 | | | | | | | | |

In the Table, means followed by the same letters are not significantly different at the 0.05 probability.

### Effect of simulated damage (by flag leaf removal) on 1000-grain weight

Data presented in Table (6) show that the highest reductions in 1000-grain weight were found with the entries Gz 11190-3-13-4-2 and Gz11332-2-2-5-3 at 100% flag leaf removal with reduction values of 9.85 and 13.41%, respectively. The commercial cultivar; Giza 177 suffered less reductiony in 1000-grain weight as compared with other genotypes.

**Table 6:** Reduction in 1000-grain weight due to flag leaf removal, at the experimental farm of Sakha Agricultural Research Station, average of 2020 and 2021 seasons

| Genotype | Control (without) | Flag leaf removal % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 25 | | 50 | | 75 | | 100 | |
| | | % | Reduction % | % | Reduction % | % | Reduction % | % | Reduction % |
| Giza 178 | 2.52 d-g | 2.42 f-i | 3.97 | 2.39 g-j | 5.16 | 2.43 e-i | 3.57 | 2.36 h-l | 6.35 |
| Giza 177 | 2.44 e-i | 2.42 f-i | 0.82 | 2.39 g-i | 2.05 | 2.39 h-j | 2.05 | 2.37 h-k | 2.87 |
| GZ10590-1-3-3-2 | 2.25 j-q | 2.23 l-q | 0.89 | 2.16 o-r | 4 | 2.11 q-s | 6.22 | 2.15 o-r | 4.44 |
| GZ11180-6-7-3 | 2.77 a | 2.64 b-d | 4.69 | 2.75 ab | 0.72 | 2.69 a-c | 2.89 | 2.68 a-c | 3.25 |
| GZ11332-2-2-2 | 2.26 j-p | 2.18 n-q | 3.54 | 2.21 m-q | 2.21 | 2.23 k-q | 1.33 | 2.15 o-r | 4.87 |
| GZ11190-3-13-4-2 | 2.03 r-t | 1.96 t | 3.45 | 1.97 t | 2.96 | 2.01 st | 0.99 | 1.83 u | 9.85 |
| GZ11456-2-1-1-2 | 2.48 e-h | 2.43 e-i | 2.02 | 2.35 h-m | 5.24 | 2.31 i-n | 6.85 | 2.26 j-p | 8.87 |
| GZ11332-2-2-5-3 | 2.31 i-n | 2.33 i-m | -0.87 | 2.27 j-o | 1.73 | 2.13 p-s | 7.79 | 2.00 st | 13.41 |
| GZ11176-2-6-3-3 | 2.39 g-j | 2.32 i-n | 2.93 | 2.27 j-o | 5.02 | 2.16 o-r | 9.62 | 2.21 m-q | 7.53 |
| GZ11236-2-6-5-2 | 2.72 ab | 2.79 a | -2.57 | 2.63 b-d | 3.31 | 2.53 d-f | 6.99 | 2.56 c-e | 5.88 |
| LSD = 0.05% | 0.118 | | | | | | | | |

In the Table, means followed by the same letters are not significantly different at the 0.05 probability

### Effect of Simulated damage (by flag leaf removal) on grain yield

Reaction of grain yield of ten evaluated rice genotypes varied with high significant differences (Table 7). The grain yield of genotype Gz 10590-1-3-3-2 was highly reduced by simulated damage with values of 9.91, 22.06, 40.16 and 43.34% yield due to 25.50, 75 and 100% flag leaf removal, respectively. Also, the grain yield of the entry Gz11236-2-6-5-2 was highly reduced; 38.87 and 49.61% at 75 and 100% flag leaf removal, respectively. The grain yields of the two commercial cultivars; Giza 177 and Giza 178 were affected by flag leaf removal, as compared to the remaining evaluated genotypes.

**Table 7:** Reduction in grain yield due to flag leaf removal, at the experimental farm of Sakha Agricultural Research Station, average of 2020 and 2021 seasons

| Genotypes | Control (without) | Flag leaf removal % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 25 | | 50 | | 75 | | 100 | |
| | | % | Reduction % | % | Reduction % | % | Reduction % | % | Reduction % |
| Giza 178 | 1220.81 bc | 1132.50 cd | 7.23 | 1117.50 c-e | 8.46 | 1003.33 d-h | 17.81 | 897.50 g-n | 26.48 |
| Giza 177 | 727.50 o-v | 688.33 q-w | 5.38 | 708.33 p-v | 2.64 | 642.50 s-x | 11.68 | 590.91 u-x | 18.78 |
| GZ10590-1-3-3-2 | 966.70 e-i | 870.92 h-o | 9.91 | 753.42 l-t | 22.06 | 578.50 v-x | 40.16 | 547.70 wx | 43.34 |
| GZ11180-6-7-3 | 860.00 h-p | 800.80 j-s | 6.88 | 745.12 m-u | 13.36 | 697.50 q-w | 18.89 | 639.42 t-x | 25.65 |
| GZ11332-2-2-2 | 1005.83 d-h | 952.50 f-j | 5.30 | 860.60 h-p | 14.44 | 877.50 h-o | 12.76 | 790.00 k-t | 21.46 |
| GZ11190-3-13-4-2 | 912.50 g-l | 955.00 f-j | -4.66 | 1015.0 d-h | -11.23 | 697.5 q-w | 23.56 | 635.00 t-x | 30.41 |
| GZ11456-2-1-1-2 | 1311.80 ab | 1405.00 a | -7.10 | 897.50 g-n | 31.58 | 940.0 f-k | 28.34 | 805.00 i-r | 38.63 |
| GZ11332-2-2-5-3 | 1087.5 c-f | 837.81 i-q | 22.96 | 953.30 f-j | 12.34 | 742.5 n-u | 31.72 | 777.50 l-t | 28.51 |
| GZ11176-2-6-3-3 | 967.5 e-i | 904.30 g-m | 6.53 | 838.80 i-q | 13.30 | 732.50 o-v | 24.29 | 676.70 r-x | 30.05 |
| GZ11236-2-6-5-2 | 1051.7 d-g | 962.60 e-i | 8.47 | 1010.00 d-h | 3.97 | 642.90 s-x | 38.87 | 530.00 x | 49.61 |
| LSD = 0.05% | 132.44 | | | | | | | | |

In the Table, means followed by the same letters are not significantly different at the 0.05 probability

### Effect of percentage of flag leaf removal on yield and yield attributes, regardless of rice genotypes

Variable percentages of flag leaf removal resulted in high significant differences in yield and yield attributes, regardless of evaluated rice genotypes (Table 8). The reductions in filled grain percentage were 4.47, 10.52, 17.59 and 23.05 due to 25, 50, 75 and 100% flag leaf removal. The 1000-grain weights were reduced by 2.07, 3.31, 4.96 and 6.61%, and grain yields were reduced by 5.95, 11.99, 25.29 and 31.86% at abovementioned flag leaf removal, respectively.

**Table 8:** Effect of percentage of flag leaf removal on yield and yield attributes of rice genotypes, at the experimental farm of Sakha Agricultural Research Station, average of 2020 and 2021 seasons

| Flag leaf removal % | Filled grain | | 1000-grain weight | | Grain yield /m$^2$ | |
|---|---|---|---|---|---|---|
| | % | Reduction % | (g) | Reduction % | (g) | Reduction % |
| Control (without) | 74.02 a | - | 2.42 a | - | 1011.20 a | - |
| 25 % | 70.71 b | 4.47 | 2.37 b | 2.07 | 951.00 b | 5.95 |
| 50 % | 66.23 c | 10.52 | 2.34 b | 3.31 | 890.00 c | 11.99 |
| 75 % | 61.00 d | 17.59 | 2.30 c | 4.96 | 755.50 d | 25.29 |
| 100 % | 56.96 e | 23.05 | 2.26 d | 6.61 | 689.00 e | 31.86 |
| F test | ** | | ** | | ** | |
| LSD=0.05% | 0.775 | | 0.037 | | 41.89 | |

In a column, means followed by the same letters are not significantly different at the 0.05 probability

## Discussion

### Insect Pest Identification

Recently, a rice skipper has been observed to infest rice plants, feeding on rice leaves, mainly the flag leaf. Specimens of this butterfly was identified as the rice skipper, *Pelopidas thrax* (Hubner) (Lepidoptera: Hesperiidae) at Systematic Laboratory of Plant Protection Research Institute, Egypt, by the aid of Prof. Dr. Ahmed S. Hendawy. In 2016, another skipper species, *Borbo borbonica* (Boisduval) has been recorded at the same location, Sakha Agricultural Research Station by [19]. However, the current identification of *Pelopidas thrax* (Hubner) confirms that of [8], also at Sakha Agricultural Research Station, Egypt.

**Host Plants and Adult Flight Activity**

As observed during trapping of this rice skipper, *Pelopidas thrax* (Hubner) by sweep net, the adults of this butterfly were observed feeding upon rice (*Oryza sativa* L.), barnyardgrass (*Echinocloa cruss-galli* L.) and juncle rice (*Echinocloa colonum* L.). During 2019, 2020 and 2021 rice seasons, it was found that this skipper had 3-4 generations in rice fields. The adult flight activity was low in June and July, relatively increased by mid-August, and reached the maximum flight activity by late August and throughout September. [20] observed feeding of *P. thrax* on various plant species of Poaceae, but not on Cyperaceae. From Poaceae, the skipper oviposited on smilograss, *Oryzopsis miliaceae* [16], with bivoltine generations a year [3]. In the collection of [2], *P. thrax* had a widespread distribution; United Arab Emirates, sub-Saharan Africa, Cyprus, Egypt and Pakistan.

**Insect Damage and Rice Yield**

In the present study, removal of 25, 50, 75 and 100% of flag leaf area reduced the rice grain yield by 5.95, 11.99, 25.29 and 31.86%, respectively. A similar trend was observed with percentages of rice filled grains, with reduction values ranging between 4.47 and 23.05%. However, the reductions in 1000-grain weight were limited, ranging between 2.07 and 6.61%. This could be explained that the rice plants are capable of compensating for the damaged leaves. Similar results were obtained by [9] who concluded that the rice plots infested with higher larval population of rice skipper produced lower rice yield compared to uninfested ones, while the rice grain quality characters were not affected.

**Natural Enemies Associated with Rice Skipper**

In the current investigation, ten parasitoids and predators were surveyed as associated with different *P. thrax* stages. The egg-parasitoid; *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae), and the pupal parasitoid, *Brachymeria* sp. (Hymenoptera: Chalcididae) were surveyed from rice fields at Sakha Agricultural Research Station. Both parasitoids were recorded as parasitoids of *P. thrax* in Hawaii [17]. A biological control program was initiated in Hawaii by [4] to eradicate *P. thrax* as a destructive insect pest in banana orchards. In addition to *T. evanescens*, *Brachymeria* sp., the hymenopterous parasitoids; *Apanteles erionate* and *Ooencyrtus erionate* greatly reduced the danger of this pest on banana. This case of control represents a successful model of biological control by introducing effective natural enemies in areas of high losses due to insect pests.

Because, *P. thrax* is still a minor insect pest in rice fields of Egypt, it is emphasized to avoid insecticide applications against this insect. Thus, alternative control methods, such as botanical insecticides could by attempted. In such concern, [6] was able to manage the rice skipper, *P. mathias* using neem (*Azadirachta indica*) seed kernel extract at 3% concentration, which efficiently reduced the feeding activity of the skipper.

**Why the Populations of *Pelopidas thrax* are low**

Forunately, the *P. thrax* populations are observed, in Egypt, as low in most cases. But because of climate change, and the possible increase of insecticide applications, this butterfly may become more occurring.

However, [15] explained why the populations of *Pelopidas mathias* (butterfly similar to our target) as follows: 1) low fecundity of the skipper, 2) wide host range of *P. mathias* which distributes the skipper on large areas, 3) the ability of the insect to adopt at variable environments, and 4) the big collection of natural enemies (as was surveyed in the current investigation) which are capable of regulating the insect populations. These reasons, all together, have resulted in what is called "diluted effects" which suppress the insect population on rice, as the target crop.

**Conclusion**

The rice skipper, *Pelopidas thrax* (Lepidoptera: Hesperiidae) is an emerging insect pest in rice fields in Egypt, feeding upon rice leaves, mainly flag leaf. Till now, this insect is considered a minor pest. Because of climatic changes and disturbances in rice ecosystem due to excessive use of pesticides, it may be expected that the insect becomes a major one in the future. Accordingly, the population of this skipper should thoroughly monitored. However, the damage of *P. thrax* in rice plants till now is limited. So, it is strongly advised to avoid pesticide applications till the economic injury levels are determined.

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**References**

1. Ankita G, Kalesh S. Reared parasitic wasps attacking hesperiids from Western Ghats (Kerala, India) with description of a new species of Dolichogenidea (Hymenoptera: Braconidae) as a larval parasitoid of *Thoressa evershedi* (Evans) (Lepidoptera: Hesperiidae). Zootaxa. 2012;3413:29-43.
2. Cock MJW, Congdom CE. Observations on the biology of Afrotropical Hesperiidae (Lepidoptera) principally from Ke11nya. Part 4. Hesperiinae Aeromachini and Baorini. In Zootaxa: 3438. 2012;16(18):1-42.
3. Cuvelier S. *Pelopidas thrax*, a new species for the island of Kos and an update of its distribution in Greece (Lepidoptera: Hesperiidae & Papilionidae). Phegea. 2009;37(3):90.
4. Davis CJ, Kawamura K. Notes and exhibitions. Proc. Hawaii Entomol. Soc. 1975;22(1):21.
5. Duncan DB. Multiple Range and Multiple F. Test. Biometrics. 1955;11:1-24.
6. Dhandapani N, Rajmohan NS, Kareem AA. Plant products as antiffedants to control insects. Pesticides. 1985;19(11):53.
7. Gupta M, Pawar AD. Biological wealth in rice ecosystem. Plant Protection Bulletin. 1992;44(3):6-15.
8. Hendawy EAS. Abundance of some insect pests and their natural enemies in rice fields. M. Sc. Thesis, Fac. Agric, Tanta Univ; c2021, p. 109.
9. Ishikazi M, Matsuyama H, Sato N. Effects of changes in density of rice skipper *Parnara guttata* (Lepidoptera: Hesperiidae) larvae in the quantity and quality of late transplanted forage rice crops. Japanese Journal of Applied Entomology and Zoology. 2017;61(3):167-173.
10. Justin O, Mansor M, Hassan AA. Seasonal abundance of

the banana skipper, *Erionota thrax* (Lepidoptera: Hesperiidae) and its parasitoids in a commercial plantation and a subsistence farm in Penang, Malaysia. International Journal of Tropical Insect Science. 2006;26(3):197-206.

11. Kharat SB, Manjrekar MD, Dumbre RB. Role of Indian bull frog in controlling rice pests. Journal of Maharashtra Agricultural Universities. 1983;8(3):223-225.
12. Kumar V, Batil BV. Status of paddy insect pests in unsprayed fields of Tungabhadra project area of Karnataka. Resistant Pest Management Newsletter. 2003;13(1):48-49.
13. Larsen TB. The butterflies of Delhi. India-anannotated check-list. Esperiana. 2002;9:459-479.
14. Larsen TB. Butterflies of West Africa, Apollo Books, Stenstrup, Denmark. 2005;2:595:270.
15. Litsinger JA, Bumroongsri V, Moril WL, Sarnthoy O. Rearing, developmental biology and host plant range of the rice skipper, *Pelopidas mathias* (F.) (Lepidoptera: Hesperiidae). International Journal of Tropical Insect Science. 2011;15(1):9-17.
16. Makris C. Butterflies of Cyprus-Bank of Cyprus cultural Foundation, Nicosia; c2003. p. 329.
17. Mau RFL, Murai K. Biological control of the banana skipper, *Pelopidas thrax* (Linnaeus), (Lepidoptera: Hesperiidae) in Hawaii. Proceedings, Hawaiian Entomological Society. 1980;203(2):231- 237.
18. Patel HN, Kadu RV, Landge SA. Study on the effect of different botanicals against rice leaf folders (*Cnaphalocrocis meolinalis* Uen. and *Pelopidas thrax* (Hub.). International Journal of Plant protection. 2011;4(1):148-152.
19. Ramadan Gh. M. Studies on certain parasitoids associated with some insect pests of rice. Ph. D. Thesis, Fac. Agric., Mansoura Univ., 2016. p. 155.
20. Tolman T, Lewington R. Field of the butterflies of Britain and Europe-Harper Collins Publishers, London, 1997. p. 320.