

## EFFECT OF HOST PLANTS ON SUNN PEST (*EURYGASTER INTEGRICEPS*) BODY WEIGHT, LIPID AND PROTEIN CONTENT

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**ABSTRACT:** The Sunn pest, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae), is a serious pest of wheat. In addition to wheat, it feeds on variety of graminous plant species including barley and rye as well as many grasses. Aim of the current study was to determine the effect of host plant on body weight, lipid and protein content of the adult Sunn pest. Results showed that host plant affected body weight of the Sunn pest. For example adult produced from nymphs grown on wheat and barley had more weight than those of rye. Also, it was observed that the adult females were produced from nymphs grown on wheat had the highest weight followed by barley and rye. Lipid content also was different based on the type of food the insect received. As can be seen the adult female were produced from nymphs grown on wheat had the highest lipid content weight followed by barley and rye. For example the amount of lipid content of the adult female grown on wheat, barley and rye was 32, 28, and 23 mg, respectively. Thus, it is concluded that host plant has profound effect on body weight, body fat content and body protein content of the adult insect which all of these parameters (body weight, body lipid content and body protein content) have important effect on the insect diapauses and the insect reproduction.

**KEY WORDS:** Sunn pest, host plants, adult weight, lipid content, protein content.

Many Heteropteran insects such as Sunn pest (*Eurygaster integriceps* Put.) (Hemiptera: Scutelleridae) that feed on plant seeds are serious agricultural pests and they usually overwinter as diapause adults (Schaefer & Panizzi, 2000). The Sunn pest has a monovoltine life cycle, with obligatory adult diapause (reproductive diapause) in each generation almost regardless of the environmental conditions it receives. Sunn pest diapause includes arrested development of female's reproductive organ and inhibition of egg deposition. Males have week diapause and diapause causes reduction maturity of their reproductive organ and sperm production for sometime (almost 45 days) post emergence. Diapause is defined as physiologically controlled suppression of growth, development or reproduction which is an adaptive mechanism for dormancy during periods of unfavorable environmental conditions (Tauber et al., 1986; Denlinger, 2008).

Duration of the Sunn pest adult diapauses depends on environment condition and it lasts about nine months which begins in the summer and ends in the late winter or early springs. After diapause termination at the end of winter or early springs, feeding is essential prior to the first mating and oviposition. Thus, the Sunn pest starts feeding after settling in the fields.

Eggs are deposited in batches of 14 usually in two rows and each row with seven eggs. The average number of eggs which are laid by each female is around 30-60. Embryonic development in laboratory conditions (at 25 -27 °C) lasts for about one week to two weeks (7-15 days) and post embryonic development lasts for about one month (27-35 days) i.e. duration of five instar nymphs is 3.6, 4.2,

3.7, 5.8 and 10 days, respectively (Radjabi, 2000). In the field conditions embryonic and post embryonic development are profoundly influenced by environmental factor such as rainfall, low and high temperatures (Popov et al., 1996).

Feeding by overwintering adults on the leaves and stems causes the plants to wither owing to damage of the growing point of central leaf known as dead heart (Critchley, 1998). In the later stages of wheat growth when ripening grain is attacked by the insect later stages serious damage is occurred i.e. damaging of ear in the bud stage causing the white ear. However, the favorite part of wheat plant for the insect feeding is wheat grains that are rich source of nutrients.

Its feeding is typical of heteropteran, piercing and cutting tissues with their stylets while injecting digestive enzymes, amylases and proteases through salivary canal to liquefy food into nutrient-rich slurry. The food slurry is ingested through the food canal and passed into the alimentary canal where it is further digested and absorbed (Cohen, 2000; Boyd et al., 2002).

Sunn pest also feed on different stage of developing grains. This insect sucks the milky nutrients from the immature grain by piercing it with their mouthparts and injecting their salivary juices, which contain very potent enzymes (Lorenz & Meredith, 1988). Because of injecting enzymes into the grain during feeding, Sunn pest enzymes degrade gluten proteins and cause rapid relaxation of dough resulting in the production of bread with poor volume and texture (Radjabi, 2000).

Feeding affects the Sunn pest fecundity which depends on internal factors such as the level of fat accumulated during the active feeding period (previous spring) and external factors such as environment factor. Fat accumulated in the fat body is consumed during migratory activities, diapauses, mating and oviposition activity (Popov, 1978). Most of accumulated fat (about 50%) is consumed for oviposition activity. During nymphal stages, as the nymphal stages progress amount of feeding intensify, too. As a result of intensifying feeding activity at the end of third instar, the nymph weighs ten times more than a newly hatched nymph. Moreover, the greatest feeding activity is observed in the fifth instar nymph and the body weight increases to 100 times that of a newly hatched nymph (Simsek et al., 1992). The Sunn pest feeds mainly on graminous plant species especially of wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*). It also feeds on grasses as well as maize and rye. It has been reported that type of the plant that insect feed affect accumulation of fat in the body (Radjabi, 2000). So, the aim of the current study is to investigate the effect of plant species such as wheat, barley and rye (*Secale cereale*) on body weight, lipid and protein content of the Sunn pest. Gained knowledge will improve our understanding of energy reserve requirements of the Sunn pest which lead to better pest management program.

## MATERIALS AND METHODS

### Insects

A stock colony of *E. integriceps* was collected from the field and maintained in the laboratory under 16L: 8D photoperiod at 26 ± 1 °C and 55% RH on soaked wheat seeds in the plastic boxes. Water was provided in circle dishes plugged with cotton wool. Also, paper strips were left in the boxes for the insect to lay egg on them. After oviposition, egg batches were collected, counted and transferred to the plot.

### **Plant species**

Three plant species including wheat (Bakrass cultivar), barley (Star cultivar) and rye (Montanum cultivar) were chosen. For each treatment (each plant species) four replicates (four plots) were considered. Each replicate (each plot) was planted in area of 15 m<sup>2</sup> (3×5 meters). Thus each species was planted in four replicates and because there were three plant species, totally 12 plots were chosen to carry out this experiments. Experiment was carried out in a *factorial-randomized block design*.

### **Plant species contamination with the Sunn pest**

Egg batches (140 individual eggs) which were stuck to paper strips by the female Sunn pest was transferred to each plot and stuck to the plant leaves. In order to confine the emerged nymphs to the plot, each plot was covered with a cloth mesh so that nymphs had to stay in the plot until yield was harvested. Then 20 adult Sunn pests (10 females and 10 males) were randomly collected from each replicate and transferred to the laboratory.

### **Determination of lipid content**

Determination of lipid was done based on Marron et al. (2003). Briefly, the insect was placed in Oven at 50 °C for 12-14 hours and then they weigh. The weighed samples were placed in a tube containing ether solvent which was left in the laboratory for 24 hours to allow time for lipid extraction. After that, the ether was removed and the insect was placed in oven at 50°C for one hour to evaporate residual ether and then they were weighed. Lipid free mass was subtracted from the dry mass to calculate the amount of lipid per insect.

### **Determination of the insect body weight and protein content**

The individual insect body weight was determined using fine laboratory balance.

In order to determine protein content, the adult Sunn pests were homogenized in ice- cold 0.02 M sodium phosphate buffer (pH 7.0). The homogenates were transferred to centrifuge tubes and centrifuged at 15000 g for 30 min at 4 °C. The supernatants were pooled and used for protein determination.

Protein was determined by the method of Bradford (1976) using bovine serum albumin as standard.

## **RESULTS**

### **Body weight**

As can be seen in Figure 1, the adult female and male of the Sunn pest have different body weight. Collectively, the adult female weighs more than the adult male. The adult female weighs about 130 mg; whilst the adult male weighs about 127 mg. There is not significant difference between the adult male and female ( $P > 0.01$ ).

Figure 2 shows that the adult produced from nymphs grown on wheat and barley have more weight than those of rye. However, there was not significant difference between the adult insect grown on wheat and barley but there was significant difference between the adult insect grown on wheat and rye ( $P < 0.05$ ).

Figure 3 shows the effect of plant species on the adult female and male weight, separately. As can be seen the adult female were produced from nymphs grown on wheat had the highest weight followed by barley and rye.

### **Determination of lipid content**

Figure 4 shows that the adult female of the Sunn pest has more fat content than adult male. There was significant difference between male and female fat

content. For example fat content of the adult male was about 25 mg while fat content of female adult was about 30 mg. It also was observed that food type affect fat content of the adults (Fig. 5). So, the adult insects were produced from nymphs grown on wheat, barley and rye had different fat content.

Figure 6 shows the effect of plant species on the fat content of the adult female and male. As can be seen the adult female were produced from nymphs grown on wheat had the highest lipid content followed by barley and rye. For example the amount of lipid content of the adult female grown on wheat, barley and rye was 32, 28, and 23 mg, respectively.

### **Determination of protein content**

Protein content of body in the adult Sunn pest was different between male and female (Fig. 7). Protein content of male was more than that of female. However, there was not significant difference between male and female protein content. Figure 9 shows that plant species affected amount of protein content in the male and female individuals. In all cases protein content of male individuals was more than female.

## **DISCUSSION**

Sunn pest is a serious pest of cereals that causes severe damage to crops (sometime up to 100%) by feeding on different part of the plants. Sunn pest damage is both quantitative and qualitative (Bandani et al., 2009). Direct feeding of the insect on the host tissues reduces the number of grain in the spike, seed germination, grain weight and yield in general.

Qualitative damage caused by injection of salivary enzymes into the grain during feeding which degrade grain storage proteins (gluten proteins). Grain proteins are divided into two groups, the monomeric gliadins and the polymeric glutenins, with the latter being further classified into high and low molecular weight (HMW and LMW) subunits (Tosi et al. 2009).

If no control measures were taken Sunn pest would reduce yield and also would decrease grain quality by lowering germination rate and baking quality of the infested grain owing to gluten hydrolysis (Popov et al., 1982; Barbulescu et al., 1987).

All parts of the host plant (graminous plant species) are attacked from the leaves and stems to the ears, depending on the stage of growth of the insect as well as the plants. First instar nymphs does not feed but from the second instar onwards they start feeding. In the early developmental stages of plant growth prior to heading the insects feed on plant leaves but in the late developmental stages of plant growth they reach late instar nymphs and adulthood which feed almost completely on the ears and kernels.

The Sunn pest feeds on graminous plants especially of wheat, barley and rye as well as grasses. In this study it was found that when insect feed on wheat they weigh more and as a result their fat content is also more than the other insects. Also when the insects feed on rye their weight is less than those that feed on the other plants such as wheat and barley.

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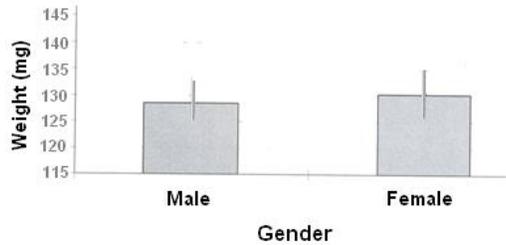


Figure 1. Adult weight of the Sunn pest when feed on three plant species including wheat, barley and rye.

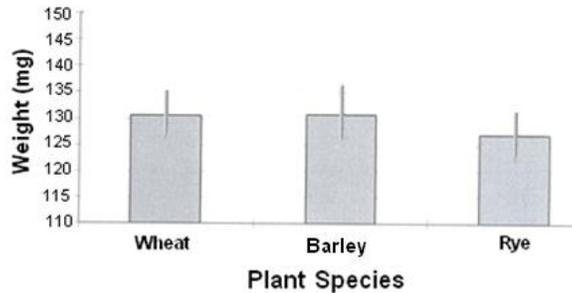


Figure 2. The adult weight of the Sunn pest when grown on three different plant species.

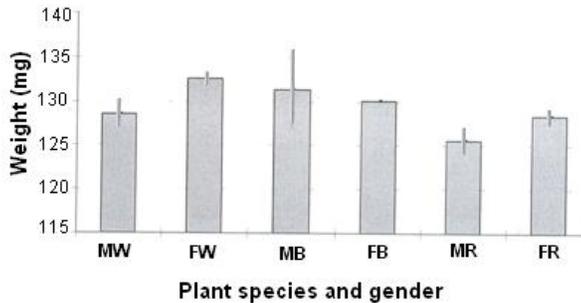


Figure 3. The effect of plant species on the adult weight of the male and female of the Sunn pest. Abbreviations are: MW: Adult males grown on wheat; FW: Adult females grown on wheat; MB: Adult males grown on barley; FB: Adult females grown on barley; MR: Adult males grown on rye; FR: Adult females grown on rye.

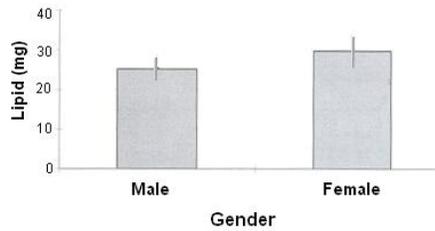


Figure 4. The amount of lipid content of the Sunn pest adult when grown on three plant species including wheat, barley and rye.

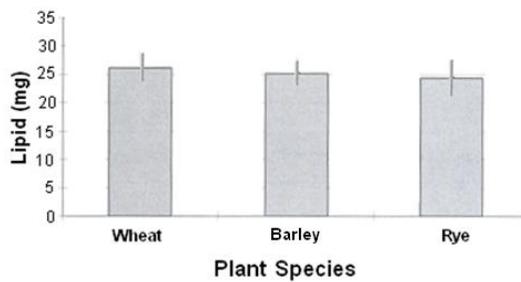


Figure 5. The lipid content of the Sunn pest adult when grown on three different plant species.

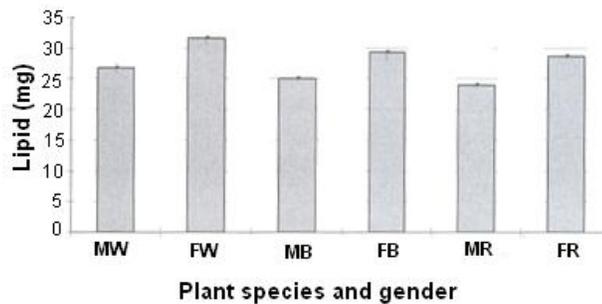


Figure 6. The effect of plant species on the lipid content of the male and female of the Sunn pest. Abbreviations are: MW: Adult males grown on wheat; FW: Adult females grown on wheat; MB: Adult males grown on barley; FB: Adult females grown on barley; MR: Adult males grown on rye; FR: Adult females grown on rye.

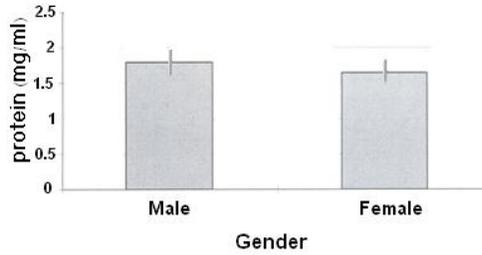


Figure 7. The amount of protein content of the Sunn pest adult when grown on three plant species including wheat, barley and rye.

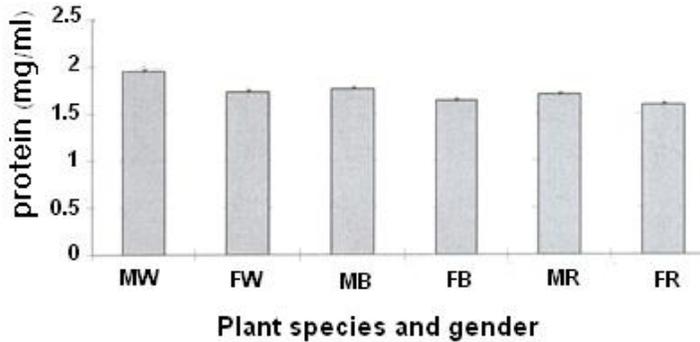


Figure 8. The effect of plant species on the protein content of the male and female of the Sunn pest. Abbreviations are: MW: Adult males grown on wheat; FW: Adult females grown on wheat; MB: Adult males grown on barley; FB: Adult females grown on barley; MR: Adult males grown on rye; FR: Adult females grown on rye.