e-ISSN 3050-9602
p-ISSN 2795-4340



GPH-INTERNATIONAL JOURNAL OF AGRICULTURE & RESEARCH

GPH - JOURNAL OF AGRICULTURE & RESEARCH

10.5281/zenodo.15721090 | Vol. 08 Issue 05 May - 2025 | Manuscript ID: #01986

# ATTACK OF THE STEM BORING PEST *Ostrinia furnacalis* Guenee (LEPIDOPTERA: PYRALIDAE) ON SWEET CORN PLANTS (*Zea mays saccharata* [Sturt.] Bailey)

***By:***

**I Made Sudarma*, Ni Nengah Darmiati*, and Dewa Ngurah Suprapta***

**Lecturer staff of Agroecotechnology Study Program, Faculty of Agriculture, Udayana University, JL. PB. Sudirman Denpasar-Bali.*

*Corresponding author mail*: madesudarma@unud.ac.id

## Abstract:

Sweet corn (Z. mays saccharata) is widely cultivated around Denpasar City, Bali as a food and vegetable, but the main obstacle to sweet corn cultivation is the attack of stem borers (*O. furnacalis*). The results of the study showed that the percentage of corn stem borer attacks ranged from 5% to 28%. The number of natural enemies showed 4.13 to 6.26 individuals. The dynamics of the corn stem borer pest population showed a range from 0.09 to 0.23. The relationship between temperature and the population of corn stem borer pests is significantly positive with a correlation coefficient of r = 0.87 ($R^2$ = 0.73), with the regression equation Y1 = 24.097 + 0.190$X_1$ ($Y_1$ = population of stem borers and $X_1$ = temperature). The relationship between stem borers and humidity has a very significant effect with a coefficient (r) = 0.94 ($R^2$ = 0.89), with the regression equation $Y_1$ = -182.815 + 2.729 $X_2$ ($X_2$ = humidity). The relationship between temperature and the population of natural enemies has a significant positive effect with a coefficient of r = 0.853 ($R^2$ = 0.73) with the regression equation $Y_2$ = 21.37 + 0.9367X1 ($Y_2$ = population of natural enemies).

## *Keywords:*

Stem borer; natural enemies; percentage of attacks; population dynamics; correlation and; regression.

***How to cite***: Sudarma, I., Darmiati, N., & Suprapta, D. (2025). ATTACK OF THE STEM BORING PEST Ostrinia furnacalis Guenee (LEPIDOPTERA: PYRALIDAE) ON SWEET CORN PLANTS (Zea mays saccharata [Sturt.] Bailey). *GPH-International Journal of Agriculture and Research*, 8(05), 72-83. https://doi.org/10.5281/zenodo.15721090

## Introduction

Indonesia's corn production in 2020 was 29.02 million tons. Nationally, the province with the largest corn production, namely East Java, contributed 23.16% to national corn production in 2020. The price of corn at the producer level in 2020 was recorded at IDR 4,888 per kg, and for rural consumers IDR 7,223 per kg, showing an increasing pattern during the 2018-2020 period. Meanwhile, the average monthly price of corn on the international market from the end of 2020 to May 2021 was observed to have experienced a high spike. The average price in 2021 to May reached USD 259.68 per ton [1]. Meanwhile, corn production in Bali province in 2015 was 19,612,435 tons. The development of production is inseparable from the expansion of corn planting areas in Indonesia, while Bali corn production in 2014 was 40,613 tons and for 2015 it was 40,603 tons. This production decline is estimated to be due to pest and disease attacks in the field [2].

Sustainable production of maize (*Zea mays* L.) as grain for feed, food and biofuel, sweet corn for fresh market or processing, and as high energy silage, requires scientific nutrient management as well as several other crop management practices such as proper plant population density, timely seeding and harvesting, groundwater, weed and pest control [3]. All of the above practices require serious attention including maize pest and disease control.

Corn yield loss by *O. furnacalis* ranges from 20-80%. Corn plants attacked by this pest become broken so that it can reduce production and even if the attack is high it can cause failure during harvest. This pest damages leaves, male flowers and then bores into the corn stalks [4]. The life cycle of this pest is 27-46 days with an average of 37.50 days. Eggs are laid in groups under the leaves. The egg period is 3-4 days. There are 5 larval instars, and the period of each instar is 3-7 days. The pupal stage is 7-9 days, and the moth period is 2-7 days. Natural enemies of the pest in South Sulawesi include the egg parasitoid *Trichogramma evanescens* and larval parasites belonging to Ichneumonidae, Braconidae and Tachinidae. Around 71.56-89.80% of eggs are infected with parasitoids. The percentage of infected larvae is 1-6%. Predators of this pest include Proreus, *Euborellia* spp., *Lycosa* spp., *Chrysopa* spp. and *Orius tristicolor* [5].

## MATERIALS AND METHODS

### Place and Time

The research was conducted in two places: 1) collection of pest and natural enemy samples was conducted in the field in Sanur Village and its surroundings, East Denpasar District, and 2) Plant Pest Laboratory, Faculty of Agriculture, Udayana University. The research was conducted from January to April 2025.

### Percentage of Attacks

To determine the intensity of damage caused by pests can be calculated using the formula proposed by [6; 7] as follows:

$P = a/b \times 100\%$.

Where: P = Percentage of attacks (%) a = Number of plants attacked b = Number of plants observed

To find out the extent of the attack category caused by stem borer pests (*O. furnacalis*), see Table 3.1

**Table 1. Percentage of attacks and attack categories [6]**

| Persentage of attacks (%) | Categories |
|---|---|
| 0 | Normal |
| $0 < x \leq 25$ | Light |
| $25 < x \leq 50$ | Moderate |
| $50 < x \leq 75$ | Heavy |
| $x > 75$ | Very heavy |

**Population Dynamics**

Population dynamics can be calculated using the following formula [8]: $Nt = No\ e^{r}$ or $dN/dt = r\ N$

Description: No = Initial population, at time t = 0 Nt = Population at time t
e = Natural logarithm base = 2.71828
r = Constant/intrinsic rate of natural growth
dN = Population change rate/time at a certain time dt = Time interval

**Relationship between Pest Population and Temperature and Humidity**

Analysis to determine the relationship between pest population and temperature and humidity used regression analysis approach, and the reciprocal relationship of both variables was calculated by correlation analysis [9].

While the regression test is used to predict variable Y, namely pest population based on variable X, namely natural enemy population (predator) in the following linear equation [10]:

$$Y = a + bX,$$

Where: Y = dependent variable,
X = variable, independent,
a = constant, line intersection on the Y axis, and
b = regression coefficient.

Hypothesis based on variance analysis table, explains the linearity test: namely:

Ho = there is no linear relationship between pest population variables, natural enemy population variables and weather factors

H1 = there is a linear relationship between pest population variables, natural enemies and weather factors.

## RESULTS AND DISCUSSIONS

### Stem Borer Attack

Symptoms of the attack are visible holes in the stem and small grains of dirt scattered around the edge of the hole (Figure 1A) and around the hole there are borer larvae that come out in the morning and hide in the stem during the day (Figure 1B). Corn yield losses by O. furnacalis range from 20-80%. Corn plants attacked by this pest become broken so that it can reduce production and even if the attack is high it causes failure during harvest. This pest damages leaves, male flowers and then bores into the corn stalk [4]. The high damage to the results is because the attack point is not only on a certain part, but almost all parts of the corn plant can be targeted. In addition, this pest also attacks all phases of corn plant growth. Because almost all parts of the plant are attacked, the symptoms of the attack can be seen on the leaves, stems, flowers, and also cobs. The impact of the larval attack has characteristics that can be observed directly with the naked eye, namely: the presence of small holes in the leaves, the presence of holes from the drilling on the stem, male flowers, or base of the cob. As a result of the drilling, the stem and male flowers become easily broken, there are piles of damaged male flowers, and damaged corn cobs [11].

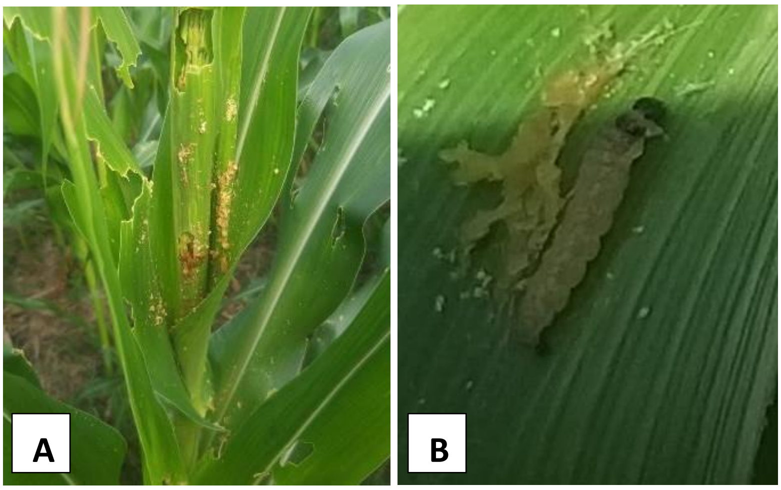


***Figure 1***. Symptoms of corn stem borer (A), and (B) corn stem borer larvae

### Percentage of Attacks

The percentage of corn stem borer attacks in all research locations showed that on Waribang Street the highest percentage of attacks reached an average of 19.28%, followed by Kertalangu Village with an attack percentage of 18%, Sedap Malam Street with an attack percentage of 11%, Sekarsari Street with an attack percentage of 9.75% and the smallest in Sanur Village reaching 7.63%. So the average percentage of attacks reached 13.15% (Table 2, Figure 2).

**Table 2. Percentage of stem borer attacks on sweet corn in East Denpasar District**

| Location | Observation (%) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | Amount | Avarage |
| Kertalangu village | 28 | 18 | 21 | 11 | 10 | 16 | 20 | 20 | 144 | 18 |
| Waribang street | 14 | 20 | 19 | 21 | 22 | 19 | 22 | 18 | 155 | 19,28 |
| Sekarsari street | 5 | 6 | 8 | 10 | 11 | 12 | 13 | 13 | 78 | 9,75 |
| Sedap Malam street | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 88 | 11 |
| Sanur village | 6 | 7 | 8 | 6 | 7 | 8 | 9 | 10 | 61 | 7,63 |
| **Amount** | **62** | **61** | **66** | **59** | **61** | **67** | **76** | **74** | **526** | **13.15** |

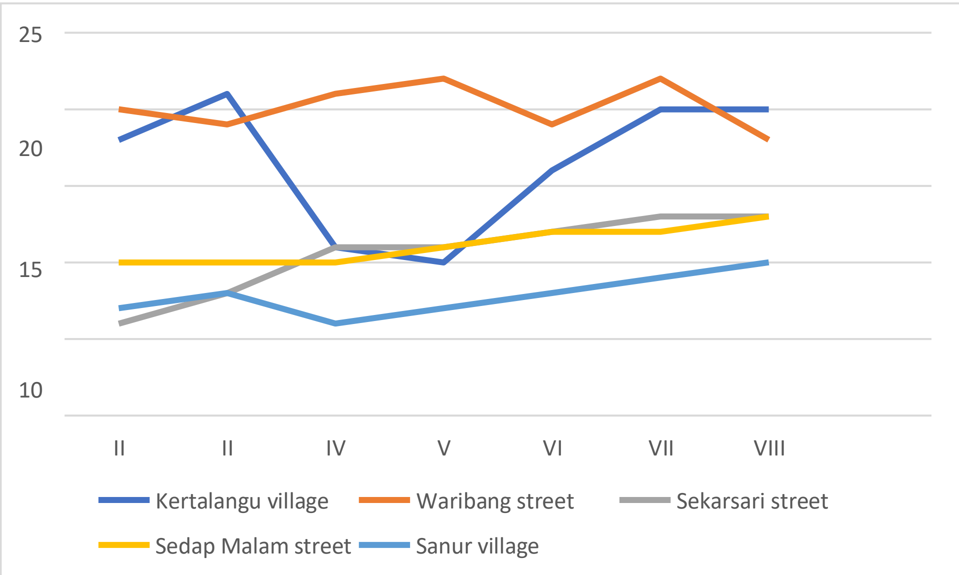


***Figure 2.*** Development of the percentage of corn stem borer attacks each week at each location

According to [6] the percentage of attacks is included in the light category. In line with the results of the study by Pratama et al. (2015) that the percentage of corn stem borer attacks is in the light category in North Tomohon District. The results of the study [12] showed that all corn varieties planted were attacked by corn stem borer larvae with the highest attack rate on the Sukmaraga and Srikandi Kuning varieties at 25 percent. The lowest attack on the Srikandi Putih variety was 12.5 percent and was more non-preferential to corn stem borers compared to other varieties. Boring holes on the Sukmaraga variety began to be found in the vegetative phase at 4.8 percent, while boring holes on the Srikandi Kuning, Srikandi Putih, and Pulut Uri varieties were 100 percent in the generative phase.

## Natural Enemy Population

The population of natural enemies in all Tabuan Locations was 5.89, Dragonflies 7.14, spiders 5.51, ladybugs 5 and bluebirds 4.38 (Figure 3). The number of natural enemies in Kertalangu Village was 4.13, Waribang Street 5.76, Sekarsari Street 6.13, Sedap Malam Street 5.64 and Sanur Village 6.26 (Table 3).

**Table 3. Population of natural enemies in East Denpasar District**

| Natural enemies name | Kertalangu village | Waribang street | Sekarsari street | Sedap Malam street | Sanur village | Amount |
|---|---|---|---|---|---|---|
| Wasp (*Vesva orientalis*) | 1 | 1.38 | 1.25 | 1.13 | 1.13 | 5.89 |
| Dragonfly (*Cordulegaster boltonii*) | 1.38 | 1.25 | 1.75 | 1.38 | 1.38 | 7.14 |
| Spider (Araneae) | 0.5 | 1.25 | 1.13 | 1.13 | 1.5 | 5.51 |
| Ladybug (*Halyomorpha halys*) | 0.75 | 1 | 1 | 1 | 1.25 | 5 |
| Wren (*Mirafra javanica*) | 0.5 | 0.88 | 1 | 1 | 1 | 4.38 |
| **Jumlah** | **4.13** | **5.76** | **6.13** | **5.64** | **6.26** | **27.92** |

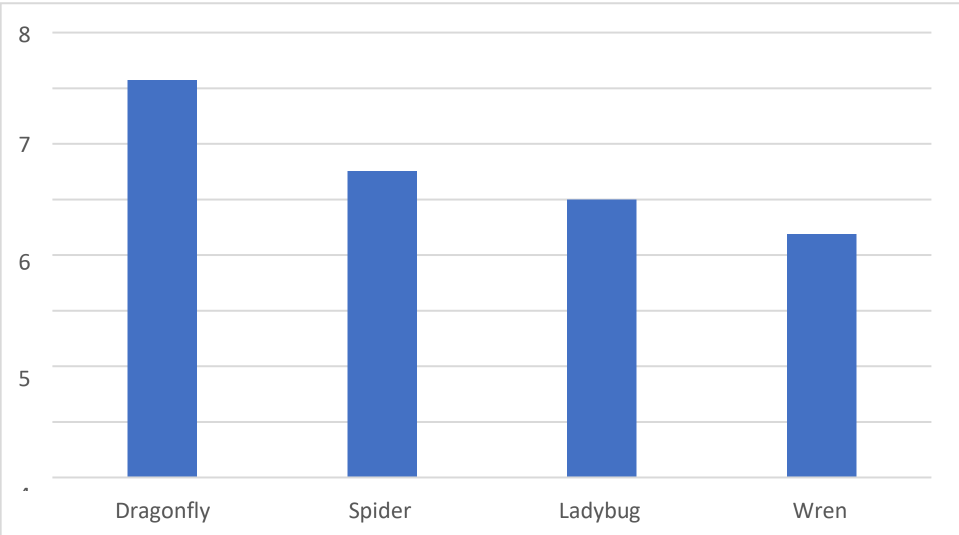


**Figure 3.** Population of natural enemies in East Denpasar District

The small pest population in Sanur Village of 7.63 individuals is due to the relatively high natural enemy population of 6.26 individuals, while the high stem borer pest population in Kertalangu Village and Jalan Waribang is 18 and 19.28 individuals respectively with natural enemies of 4.13 and 5.76 individuals (Table 3). It is common in nature that pests will be high if the natural enemy population is high, and vice versa (Figure 4). The use of natural enemies in controlling corn stem borers (*O. furnacalis*) is an effective and environmentally friendly method. Natural enemies such as Trichogramma wasps, Argiopidae, Oxyopidae, and Theriidae spiders, as well as *Selonepsis germinata* and *Proreus simulans* ants, play an important role in suppressing the population of this pest.

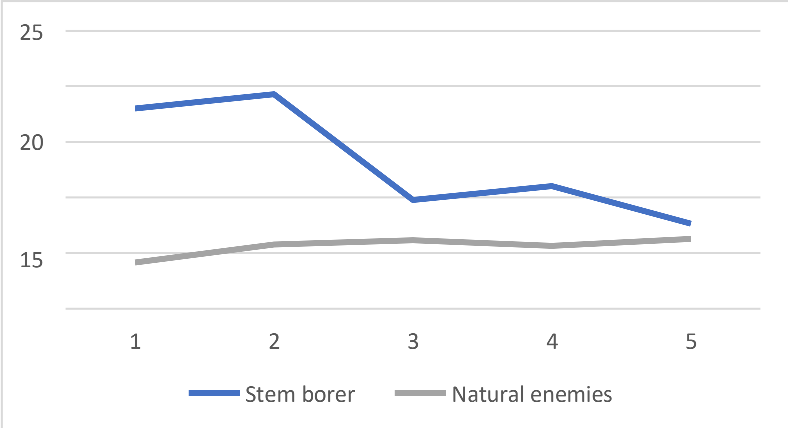


*Figure 4*. Development of corn stem borer population compared to development of natural enemy population

**Population Dynamics**

Population dynamics of plant pests refers to the study of changes in the number and distribution of pests in a given area and time. This includes the processes of growth, reproduction, death, migration, and interactions between pests and environmental factors that affect their populations. The population dynamics of corn stem borer pests showed that the highest was from week IV to V at 0.83 followed by observations from I to II at 0.80 (Table 5). This means that out of a hundred, only 83 or 80 pests were born in a week. Week I increased to Week II, then decreased, and weeks III to V increased again and then decreased.

According to Dadang [13], the factors that determine the high and low population of an organism are determined by internal, external and food factors. Internal insect factors include life cycle, sex ratio, and personality. The life cycle is the length of time for insect development from eggs to the insect laying eggs for the first time. The shorter the life cycle, the faster the insect population development. Sex ratio is the comparison of male and female insects where the more females produced, the faster the population by a female, this is the higher the level of personality of an insect, the faster the insect population will grow.

**Table 5. Population dynamics of sweet corn stem borer**

| Lokasi | Observation | | | | | | |
|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII |
| Kertalangu village | 0.09 | 0,.17 | 0.07 | 0.13 | 0.23 | 0.17 | 0.14 |
| Waribang street | 0.20 | 0.14 | 0.16 | 0.15 | 0.12 | 0.17 | 0.12 |
| Sekarsari street | 0.17 | 0.19 | 0.18 | 0.16 | 0.16 | 0.15 | 0.14 |
| Sedap Malam street | 0.16 | 0.14 | 0.16 | 0.14 | 0.16 | 0.14 | 0.15 |
| Sanur village | 0.17 | 0.16 | 0.11 | 0.17 | 0.16 | 0.16 | 0.16 |
| **Amount** | **0.79** | **0.80** | **0.68** | **0.75** | **0.83** | **0.79** | **0.71** |

External factors consist of abiotic and biotic environments. Abiotic environments include rainfall, temperature, humidity and others that will limit or encourage insect populations to grow. Biotic factors include predators, parasitoids, pathogens, competitors and others. The presence of predators and parasitoids in a plantation will determine the development of insect pests. Food factors are other factors that greatly determine the development of insect pest populations. Food quality and quantity factors will influence the high and low levels of population development [13].

### Relationship between Pest Population, Natural Enemies with Temperature and Humidity

The relationship between temperature and the population of corn stem borer pests was significantly positive with a correlation coefficient of r = 0.87 ($R^2$ = 0.73), with the regression equation $Y_1 = 24.097 + 0.190X1$ ($Y_1$ = stem borer pest population and $X_1$ = temperature) (Figure 5).

The relationship between stem borer pests and humidity has a very significant effect with a coefficient (r) = 0.94 ($R^2$ = 0.89), with the regression equation $Y_1 = -182.815 + 2.729 X_2$ ($Y_2$ = stem borer pests and $X_2$ = humidity) (Figure 6). This means that corn stem borer pests are very much determined by temperature and humidity. The higher the temperature and humidity to a certain limit, the higher the population of the pest.

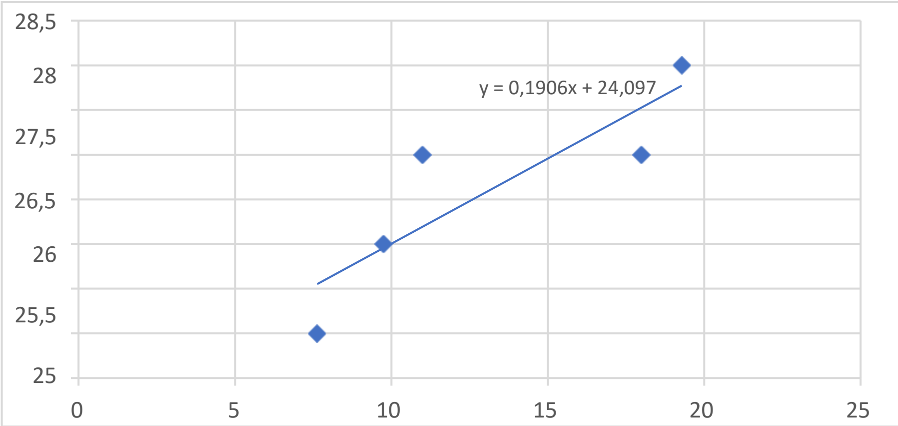


***Figure 5***. Relationship between temperature and population of stem borer

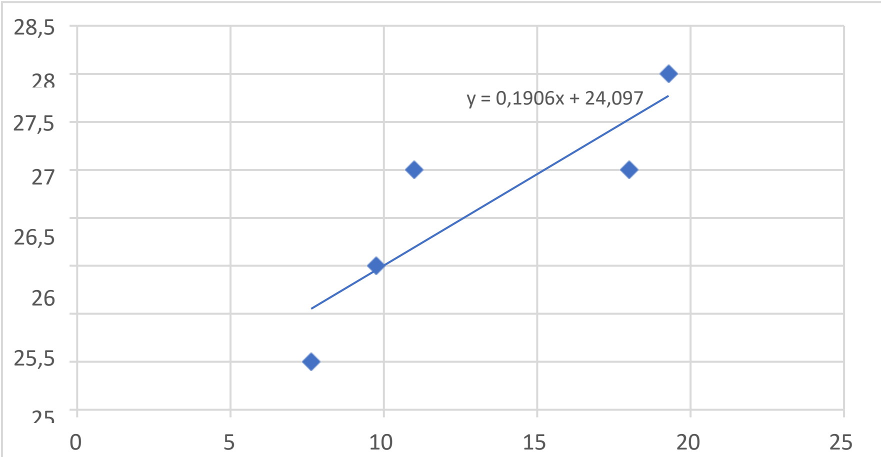


***Figure 6.*** Relationship between relative humidity and population of stem borer

When both temperature and humidity are connected to the population of corn plant pests, the following regression equation is obtained Y1 = -187.639 - 0.301X1 + 2.908X2 (Y1 = pest population, X1 = temperature and X2 = humidity).

The relationship between temperature and natural enemy population has a significant positive effect with a coefficient of r = 0.853 ($R_2$ = 0.73) with the regression equation $Y_2$ =

21.37 + 0.9367$X_1$ ($Y_2$ = natural enemy population and $X_1$ = temperature) (Figure 8). While the relationship between natural enemy population and humidity is not significant. The relationship between natural enemy population and corn stem borer pest population shows no significant effect.

Temperature plays a significant role in the development of corn stem borers. The ideal temperature range for corn stem borer development is generally between 50° and 85°F (10° and 30°C). Lower or higher temperatures can inhibit their growth and reproduction

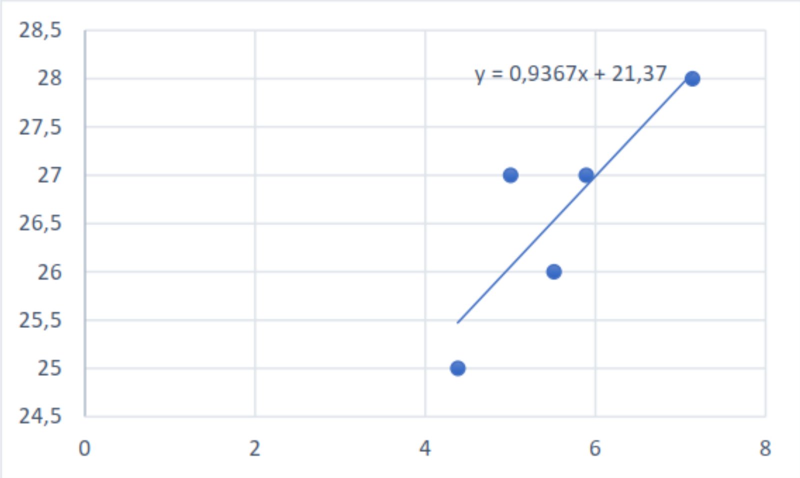


Figure 7. Relationship between natural enemies and temperature

The results showed that *O. furnacalis* at the egg or larval stage was more sensitive to a single heat wave than at the pupal or adult stage. After a single heat wave, *O. furnacalis* showed reduced egg hatching or reduced larval survival, but the optimum temperature for egg hatching and larval survival was higher than that in the control. The upper temperature threshold and optimum temperature for larval development in the control were higher than those after a single extreme heat wave. Male and female pupal weights decreased with increasing temperature, and pupal weights decreased more rapidly in females than in males. Cox proportional hazards models showed that when *O. furnacalis* developed at 25°C, the risk of immediate adult mortality following a 3-h heat wave at the egg stage was higher than in controls, but when *O. furnacalis* developed at 29°C and 31°C, the risk of immediate adult mortality following a heat wave was significantly lower than in controls. Our study highlights the impact of a single heat wave on *O. furnacalis* eggs and the subsequent development of surviving individuals [14].

The relationship between temperature and corn stalk borer (*O. furnacalis*) is positive. This means that the higher the temperature, the larger the corn stalk borer population. Warm and humid temperatures are ideal conditions for the growth and development of corn stalk borer larvae. Temperature has a significant impact on the biology of corn stalk borers, especially the European corn stalk borer (*O. nubilalis).* High temperatures can affect reproductive traits, leading to increased reproductive investment with less preferred partners. Specific temperature effects include increased developmental rates, altered synchrony of adult emergence, and decreased egg production, especially during the pupal and adult stages.

European corn borer, *O. nubilalis* (Hübner), egg hatching was studied under several temperature and humidity conditions. The hatching percentage decreased drastically, regardless of humidity, at 36 and 39°C. Hatching ranged from 74.0 to 0.5% at a vapor pressure deficit of 7.5–32.5 mb in the temperature range of 24–33°C with a 3°C increase. European corn borer egg hatching was similarly affected, from oviposition to larval hatch, by 12-hour stress periods of 14.5, 17.5, and 20.5 mb (at 30°C) [15].

## CONCLUSION

The percentage of attacks shows a light category, with the population of borer pests getting bigger and the population of natural enemies is getting bigger. The dynamics of the pest population increased in weeks I to II and IV and V, this is in accordance with the development of natural enemies. The relationship between temperature and pest population shows a significant effect, while the relationship between humidity and the population of beaked pests is very significant. The relationship between temperature and natural enemies has a significant effect but the relationship between humidity and natural enemies has no significant effect. While the relationship between the population of natural enemies and the borer pest population has no significant effect.

**Acknowledgements**

Authors wish to thank to the Rector of Udayana University for their assistance and the opportunity given so that research can be resolved, Dean of the Faculty of Agriculture, Udayana University, and Chairman of the Institute for Research and Community Service Udayana University, for their help and cooperation so that research can be funded to completion.

**References**

Komalasari, W.B. 2021. Analisis kinerja perdagangan jagung. Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal Kementerian Pertanian. Jakarta.

Badan Pusat Statistik (BPS) Indonesia. 2019. Produksi Jagung Menurut Provinsi (ton), 1993-2015. Jl. Dr. Sutomo, 6-8 Jakarta.

Subedi K.D. and B. L. Ma. 2011. Corn Crop Production: Growth, Fertilization and Yield. Eastern Cereal and Oilseed Research Centre (ECORC), Agriculture and Agri-Food Canada (AAFC), Central Experimental Farm, 960 Carling Avenue, Ottawa, ON, K1A, 0C6, Canada.

Pabbage, M.S, A.M. Adnan, dan N. Nonci. 2007. Pengelolaan Hama Prapanen. Balai Penelitian Tanaman Serealia. Maros http://pustaka.litbang.deptan.g o.id/bppi/lengkap/bpp10202.pd f (2 Mei 2017).

Nonci, N. 2004. Biologi dan Musuh Alami Penggerek Batang Ostrinia furnacalis Guenee (Lepidoptera: Pyralidae) pada Tanaman Jagung. Jurnal Litbang Pertanian 23: 8–14.

Natawigena, H. 1989. Entomologi Pertanian. Fakultas pertanian Universitas Padjajaran,BandungNatawigena, 1982

Kementrian Pertanian, 2020. Hama Tanaman Jagung. Kementrian Pertanian. Simluhtan. Katam Terpadu Modern.

Rondo S.F., I M. Sudarma, dan G. Wijana. Dinamika Populasi Hama dan Penyakit Utama

Tanaman Jagung Manis (Zea mays saccharata Sturt) pada Lahan Basah dengan Sistem Budidaya Konvensional serta Pengaruhnya terhadap Hasil di Denpasar-Bali. Agrotorp 6(2): 126-136.

Gomes, K.A. dan A.A. Gomes, 2007. *Prosedur Statistik untuk Penelitian Pertanian*. Edisi kedua. Penerbit Universitas Indonesia (UI-Press). Jakarta.

Ilys A. dan F. Djufri, 2013. Analisis Korelasi Dan Regresi Dinamika Populasi Hama Dan Musuh Alami Pada Beberapa Varietas Unggul Padi Setelah Penerapan Pht Di Kabupaten Bone Provinsi Sulawesi Selatan (Correlation and Regression Analysis Pest Population and Natural Enemy Dynamic of Certain Varieties Rice After Implementation of Superior Ipm in Bone South Sulawesi). Infromatika Pertanian 22(1): 29-36.

Dekan A. dan E. Dodgson. 2022. Penggerek Batang. Pengelolaan Tanaman Terpadu. Iowa State University.

Subedi K.D. and B. L. Ma. 2011. Corn Crop Production: Growth, Fertilization and Yield. Eastern Cereal and Oilseed Research Centre (ECORC), Agriculture and Agri-Food Canada (AAFC), Central Experimental Farm, 960 Carling Avenue, Ottawa, ON, K1A, 0C6, Canada.

Dadang. 2006. Konsep Hama dan Dinamika Populasi. Workshop Hama dan Penyakit Tanaman Jarak (Jatropha curcas Linn.):Potensi Kerusakan dan Teknik Pengendaliannya Bosor, 5-6 Desember 2006. Departernen Proteksi Tanaman, Fakultas Pertanian. IPB.

Zhou, J., Q. Liu, Y. Han and H. Dong. 2018. High temperature tolerance and thermal-adaptability plasticity of Asian corn borer (*Ostrinia furnacalis* Guenée) after a single extreme heat wave at the egg stage. Journal of Asia Pacific Entomology 21(3): 1040-1047.

Godfrey L.D., and T.O.Holtzer, 1991. Influence of Temperature and Humidity on European Corn Borer (Lepidoptera: Pyralidae) Egg Hatchability. Environmental Entomology, 20(1): 8–14.