**PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY**

**DEPARTMENT OF AGRICULTURE**

**FIRST SEMESTER FINAL EXAMINATION 2020**

**AG 214: AGRICULTURAL ENTOMOLOGY**

**DATE OF EXAMINATION: 15th JUNE 2020**

**TIME: 8:20 AM**

**TIME ALLOWED: 3 HOURS**

**TOTAL MARKS: 50**

**INFORMATION FOR CANDIDATES**

1. Sanitize your hands before entering the room and wear face masks during the examination.
2. You have 10 minutes to read the paper. You must not begin writing during this time.
3. Write your name and student number clearly on the front page of your answer booklet.
4. Answer all the questions only in the answer booklet provided. No other papers will be accepted.
5. This is a closed book examination. Notes and textbooks are not allowed during the examination.
6. The marks for each question are given within parentheses at the end of each question.
7. All mobile phones must be switched **OFF**.

## QUESTION ONE (5 marks)

Define the following terms;

a. Arthropod pest
b. Economic threshold level
c. Density-independent factors
d. Malpighian tubules
e. Mimicry

## QUESTION TWO (2+3 = 5marks)

a. Discuss why regular insecticide use should be discouraged by adopting integrated pest management.
b. How do you evaluate the compatibility of insecticides and pest natural enemies?

**QUESTION THREE (10 marks)**

The larval stage of diamond-back moth (DBM) is a devastating pest of cabbages. During sampling: you recorded DBM eggs and larvae, cabbage moth eggs and caterpillars, true armyworm moth eggs and larvae, Trichogramma wasps and Diadegma wasps, jumping spiders, wagtail birds and *Beauveria*-infected DBM larvae.

Sate the specific types of interactions in cabbage agroecosystem.

a. DBM larvae and cabbage
b. DBM larvae
c. Larvae of DBM, cabbage moth, true armyworm moth
d. DBM larvae, *Beauveria*
e. Wagtail birds
f. Eggs of DBM, Trichogramma wasps
g. Jumping spiders, Diadegma wasps, *Beauveria*
h. Cabbage pests, jumping spiders
i. Wagtail birds, cabbage pests
j. Diadegma wasps, cabbage moth caterpillars

**QUESTION FOUR (3+4+6+3+4 = 20 marks)**

You reared 2 pairs of coconut rhinoceros beetles in captivity, and recorded 6 eggs and 4 2$^{nd}$ instar larvae after a month. Only 75% of the 1$^{st}$ instar larvae will make it to 2$^{nd}$ instar larvae.

a. What is the average female fecundity?
b. Calculate the intrinsic growth rate.
c. Explain 3 probable causes of 1$^{st}$ larval instar deaths.
d. What will be the projected population after 3 months?
e. If the carrying capacity (K) of a garden is 20 beetles, how long does it take to reach that K?

**QUESTION FIVE (10 marks)**

Write to fill the missing cells given in the table below.

| **Pest species** | **Order** | **Development** | **Pest mouthpart type** | **Principle host crop** |
|---|---|---|---|---|
| *Papuana woodlarkiana* | a. | Holometabolous | b. | c. |
| *Zophiuma butawengi* | d. | e. | Piercing-sucking | Coconut |
| *Sesamia grisescens* | Lepidoptera | f. | g. | h. |
| *Sexavae* sp. | i. | j. | Cutting-chewing | Oil palm |

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7. All mobile phones must be switched **OFF**.

**QUESTION ONE (5 marks)**

Define the following terms;

a. Arthropod pest-any insect or mite/tick that causes substantial loss to agricultural crop/livestock production, and its control is warranted
b. Economic threshold level-or the 'action threshold' is the density of pest species in which control should be initiated before cost of control exceeds profit (yield loss).
c. Density-independent factors-factors that influence the population size of any pest species, irrespective of its density.
d. Malpighian tubules-organ found in insect species responsible for excretion of N products, other metabolites and water re-absorption.
e. Mimicry-adaptation in which prey/predator co-evolve to escape/lure each other for survival.

**QUESTION TWO (2+3 = 5marks)**

a. Discuss why regular insecticide use should be discouraged by adopting integrated pest management.
   Frequent application of insecticides leads to insecticide resistance development, killing of beneficial arthropods (pollinators, natural enemies, soil nutrient recyclers), resurgence of minor pest species, human health issues and environment/soil contamination. Thus IPM should be adopted to minimize the use of insecticides and be only used as the 'last resort'.

b. How do you evaluate the compatibility of insecticides and pest natural enemies?
   To evaluate NE compatibility with insecticides, sampling has to be conducted at insecticide post-application. This is vital to determine the activity of NEs after insecticide is applied. If the NEs populations are low at post-treatment, the product is said to be incompatible with NE present.

**QUESTION THREE (10 marks)**

The larval stage of diamond-back moth (DBM) is a devastating pest of cabbages. During sampling: you recorded DBM eggs and larvae, cabbage moth eggs and caterpillars, true armyworm moth eggs and larvae, Trichogramma wasps and Diadegma wasps, jumping spiders, wagtail birds and *Beauveria*-infected DBM larvae.

Sate the specific types of interactions in cabbage agroecosystem.

a. DBM larvae and cabbage (HERBIVORY, insect-plant association)
b. DBM larvae (Intra-specific competition)
c. Larvae of DBM, cabbage moth, true armyworm moth (Inter-specific competition)
d. DBM larvae, *Beauveria* (PARASITISM, insect-pathogen association)
e. Wagtail birds (Intra-specific competition)
f. Eggs of DBM, Trichogramma wasps (PARASITISM, insect-insect association)
g. Jumping spiders, Diadegma wasps, *Beauveria* (Inter-specific competition)
h. Cabbage pests, jumping spiders (PREDATION, insect-arthropod association)
i. Wagtail birds, cabbage pests (PREDATION, prey-predator association)
j. Diadegma wasps, cabbage moth caterpillars (PARASITISM, insect-insect association)

**QUESTION FOUR (3+4+6+3+4 = 20 marks)**

You reared 2 pairs of coconut rhinoceros beetles in captivity, and recorded 6 eggs and 4 2$^{nd}$ instar larvae after a month. Only 75% of the 1$^{st}$ instar larvae will make it to 2$^{nd}$ instar larvae.

a. What is the average female fecundity?
   Births = (6+4=10); fecundity = 10/2 females = **5 eggs/female**
b. Calculate the intrinsic growth rate.
   $r = [(B-D)+(I-E)]/N_0$
   $N_0$ = 4; births = 6+4; deaths = 4-(4*.75)=4-3=1; immigration=0; emigration=0
   r = [(10-1)+(0-0)]/4=**2.25**
c. Explain 3 probable causes of 1$^{st}$ larval instar deaths.
   - Competition for food results in starvation
   - Genetic abnormalities
   - Cannibalism & injury

d. What will be the projected population after 3 months?

Using equation $N=N_0(1+r)^t$

| Time, mo | N |
|---|---|
| 0 | 4 |
| 1 | 13 |
| 2 | 40.25 (40) |
| 3 | 137.3 **(137)** |

e. If the carrying capacity (K) of a garden is 20 beetles, how long does it take to reach that K?

Using rN(K-N/K)

| T | N | K-N/K | dN/dT |
|---|---|---|---|
| 0 | 4 | 0.92 | 2.07 |
| 1 | 6.07 | 0.8786 | 1.97685 |
| 2 | 8.04685 | 0.839063 | 1.887892 |
| 3 | 9.934742 | 0.801305 | 1.802937 |
| 4 | 11.73768 | 0.765246 | 1.721804 |
| 5 | 13.45948 | 0.73081 | 1.644323 |
| 6 | 15.10381 | 0.697924 | 1.570329 |
| 7 | 16.67413 | 0.666517 | 1.499664 |
| 8 | 18.1738 | 0.636524 | 1.432179 |
| 9 | *19.60598* | 0.60788 | 1.367731 |

About **9 months** to reach 20 beetles

**QUESTION FIVE (10 marks)**

Write to fill the missing cells given in the table below.

| Pest species | Order | Development | Pest mouthpart type | Principle host crop |
|---|---|---|---|---|
| *Papuana woodlarkiana* | a. Coleoptera | Holometabolous | b.Cutting-chewing | c. taro |
| *Zophiuma butawengi* | d. Hemiptera | e. Hemimetabolous | Piercing-sucking | Coconut |
| *Sesamia grisescens* | Lepidoptera | f. Holometabolous | g. Cutting-chewing | h. Sugarcane |
| *Sexavae* sp. | i. Orthoptera | j. Hemimetabolous | Cutting-chewing | Oil palm |