

BIOLOGICAL PROPERTIES OF *RHOPALOSIPHUM PADI* LINN. IN TWO HABITATS WITH DIFFERENT CLIMATIC REGIMES

Yonny Koesmaryono * and Tetsuya Haseba **

* PhD Student on Agricultural Meteorology, College of Agriculture, Ehime University, Japan.

** Professor of Agricultural Meteorology, College of Agriculture, Ehime University, Japan.

ABSTRACT

Experiment on *R. padi* was conducted on wheat crop at two sites with distinct altitudes, Cipanas (1100 m) and Darmaga (250 m). Wheat crop was grown inside cages at the two sites. Temperature and humidity inside and outside the cages and biological properties were compared between the two sites. Different temperatures between the two sites caused significant difference of biological properties of *R. padi* comprising fecundity, number of moulting, length of larval stages, longevity and population growth. In Cipanas, with lower temperatures, *R. padi* had greater fecundity and number of moulting, longer length of larval stages and longevity and faster population growth than that in Darmaga. The study suggests that varying climatic regimes between Cipanas and Darmaga is tolerable to growth of *R. padi*.

Key Words : Biological properties of *Rhopalosiphum padi*, climate

Indonesia has recently directed research towards growing wheat at high altitudes. The objective is to reduce import of wheat which increases every year. In the future, it is expected that the crop can also be grown at lower altitudes. To achieve this goal, crop management including crop protection of wheat crop should be considered. One important pests is *Rhopalosiphum padi* which has been recognized as a pest of maize in Indonesia. This aphid can cause severe damage on wheat caused by the pest itself or by diseases carried by the pest (as a vector). A study on biological properties of *R. padi* in relation to climatic environment conducted in this experiment will be important to support management of the wheat crop. The study includes understanding of life cycle and distribution of the pest on wheat crop.

There were two objectives of this experiment. First, to determine and analyze the effect of different climatic regimes to biological properties of *R. padi*. Second, to observe distribution of *R. padi* with altitudes.

METHODS

Two sites in West Java, Indonesia, with different climates were selected. One site is at Cipanas (1100 m above sea level, 6° 45' S) the other at Darmaga (250 m, 6° 30' S). The average temperature at Cipanas is 21.2 °C in contrast to 25.3 °C at Darmaga.

The experiment employed a complete, randomized design with two treatments (sites Cipanas and Darmaga) and 5-20 replications. At each site, the aphids (*R. padi*) were taken from pure population and were grown on wheat plants. The wheat plants were planted on pots and laid in the field under a cage (i.e. a small green house). Observations were carried out for biological properties which comprise fecundity, longevity, number of moulting, length of larval stage and population growth. The distribution of *R. padi* was determined from occurrence at maize crop along the road from Cipanas to Darmaga (50 km distance). Observation for climatic variables includes macroclimate, based on routinely measured data on meteorological station, and air temperatures and humidity under the cage.

RESULTS AND DISCUSSION

Climatic differences between Cipanas and Darmaga

Different climate between Cipanas and Darmaga are the result of distinct altitudes (850 m difference) and topography between the two sites. Average temperature at Cipanas is 4.1 °C lower than that at Darmaga at lower altitude, while air humidities of the two sites are similar (Fig. 1). Cipanas has lower annual rainfall (3084 mm) than Darmaga (3711 mm) as shown in Fig. 2. The higher rainfall at Darmaga is due to orographic influence of Mt. Salak and its relative position to the Java Sea (windward). On the other hand, Cipanas lies on the leeward side of Puncak Hill which consequently yield a low rainfall. Despite the lower rainfall sunshine duration at Cipanas (4.4 hours) is shorter than at Darmaga (7.3 hours).

Based on water balance analysis, Darmaga tends to have surplus of water throughout the year due to the high rainfall (Suharsono, 1982). Cipanas, with the lower rainfall, may experience water deficit during the period of July-October. However, the low temperatures at Cipanas may reduce negative impact of water deficit on crop growth.

Relationship between biological properties of *R. padi* and climatic variables

Table 1 presents air temperature and humidity inside cages at Cipanas and Darmaga for the period of 30 days.

The biological properties of *R. padi* were statistically different between the two sites caused by different temperatures and humidity (Table 1). Number of moulting was four to five times at Cipanas and was four times at Darmaga. The result was that there were four to five nymphae of larval stage at Cipanas compared with four nymphae at Darmaga (Fig. 3). Differences in longevity and fecundity between the two sites are presented in Fig. 4. Average length of imago was 1.84 mm at Cipanas while in Darmaga was only 1.49 mm.

Table 1. Average, daily temperature (Temp) and humidity (RH) inside cages at Cipanas and Darmaga

Observations	Sites			
	Cipanas		Darmaga	
	Temp. (°C)	RH (%)	Temp. (°C)	RH (%)
1. Length of larval stage	21.6	76	27.4	76
2. Longevity and fecundity	21.7	79	27.1	73
3. Population growth	21.7	75	27.0	75

Population growth rate of *R. padi* at Cipanas was faster especially after day 7 (Fig. 5). At day 30, the population structure is presented in Table 2. From Table 2, the population at the two sites were dominated by larval stages and this indicates the growing population (Sunjaya, 1970).

Table 2. Population structure of *R. padi* at Cipanas and Darmaga

Description	Cipanas (%)	Darmaga (%)
Larval stage 1-2	80.5	74.9
Larval stage 3-5	6.5	10.2
winged imago	8.7	5.2
unwinged imago	4.2	9.7

Andrewartha and Birch (1974) have stated that lifecycle of homeoterm insects is shorter in hot than in cooler region due to faster metabolism. In relation to this, the differences in developmental rates, longevity and length of imago between Cipanas and Darmaga were related to the different temperatures inside the cages (Table 1). Furthermore, Wigglesworth (1974) reported factors which could influence fertility and fecundity of insects comprising temperature, nutrition and hormone. In the present experiment, differences in air temperatures between the cages caused a significant effect on fecundity. Fecundity of *R. padi* at Cipanas was much greater than that at Darmaga (Table 2). Besides, the temperature also affected growth of wheat so that the effect of temperature on biological properties of *R. padi* was indirectly through the supply of nutrition which was related to the plant growth.

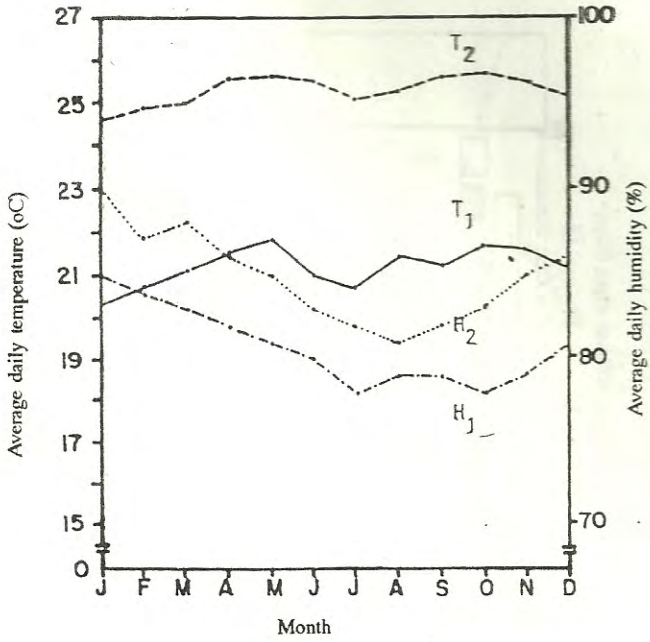


Fig. 1. Average daily air temperature and humidity T₁/H₁ at Cipanas and T₂/H₂ at Darmaga.

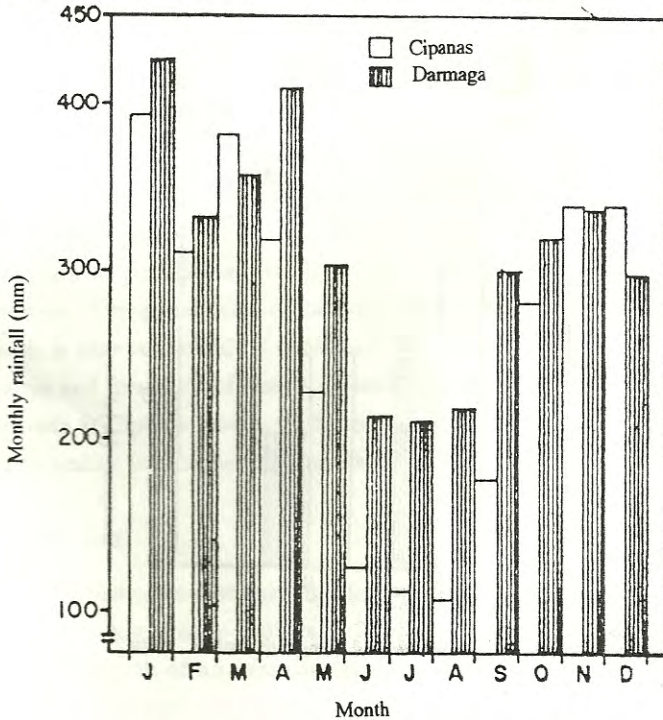


Fig. 2. Histogram of rainfall at Cipanas and Darmaga

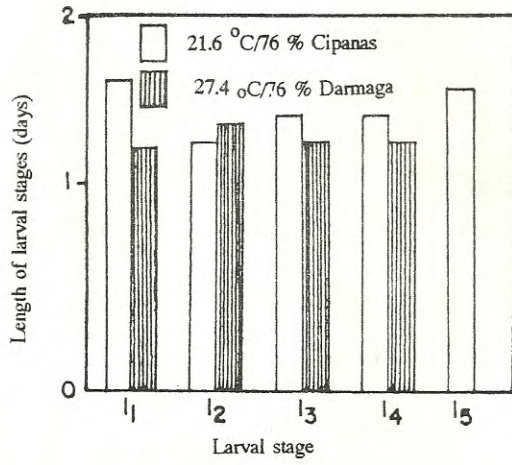


Fig. 3. Average length of larval stages of *R. padi*

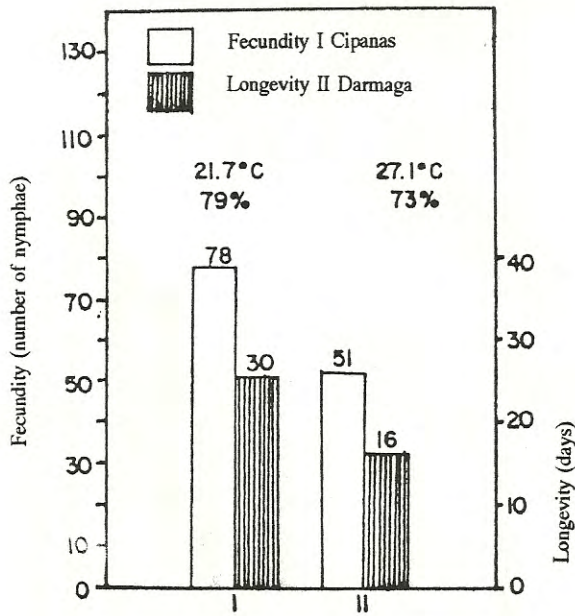


Fig. 4. Average fecundity and longevity of *R. padi*

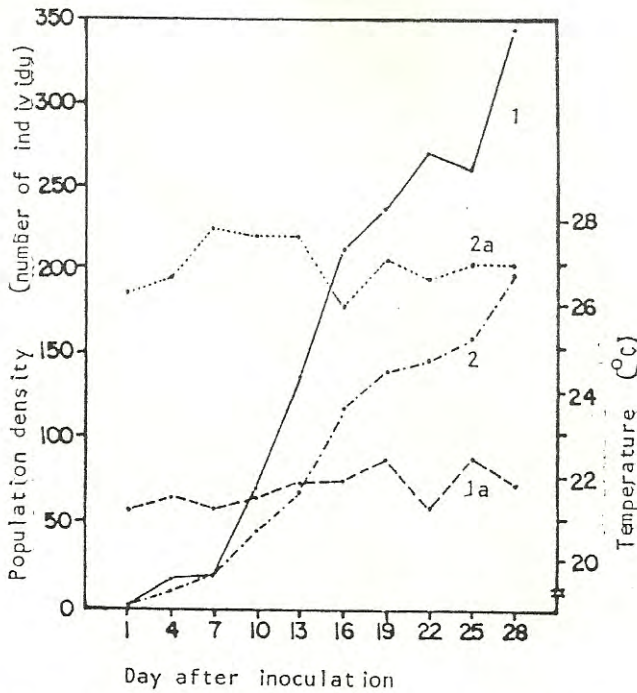


Fig. 5. Population growth differences between Cipanas and Darmaga

1. Population growth at Cipanas
- 1a. Average temperature. at Cipanas
2. Population growth at Darmaga
- 2a. Average temperature at Darmaga

In relation to population growth, Clark *et al.* (1967) suggested that the growth is controlled by rates of birth and death of the population. In addition, Sunjaya (1970) suggested that the growth is also controlled by quality of food since its quality has great influence on the development and fecundity of insects. Based on these arguments, it is not surprising that population growth at Cipanas was much better than that at Darmaga. Despite shorter rate of development fecundity was higher at Cipanas.

Distribution of *R. padi*

The result indicates that varying climatic regimes between Cipanas (1100 m) and Darmaga (250 m) is tolerable to growth of *R. padi*. This is consistent with observation by Krebs (1978) that growth of an organism depends on air temperature, humidity, water and light only of a certain range.

CONCLUSIONS

Different altitudes between Cipanas (1100 m) and Darmaga (250 m) causes distinct climatic regimes and, hence, biological properties of *R. padi* (fecundity, number of moulting, length of larval stages, longevity and population growth).

Varying climatic regimes between Cipanas and Darmaga is tolerable to growth of *R. padi*.

ACKNOWLEDGMENTS

The authors wishes to expresses particular thanks to Dr. Ir. M. Bl de Rozari (Bogor Agricultural University) for his helpful advice and comments during the writing of this article. The author also wants to thanks to Dr. Ir. Handoko (Bogor Agricultural University) for his valuable advice and comments for this work.

REFERENCES

- Andrewartha, H.G. and L.C. Birch. 1974. The distribution and abundance of animals. Sixth Impression. The University of Chicago Press, Chicago & London, 782pp.
- Clark, L.R., P.W. Geier, R.D. Hughes, dan R.F. Morris. 1967. The ecology of insectt populations in theory and practice. The English Language Book Soc. and Chapman & Hall, London, 232p.
- Krebs, C.J. 1978. Ecology the experimental analysis of distribution and abundance. 2nd ed. Harper & Row, Publ., New York 678p.
- Suharsono, H. 1982. Beberapa aspek iklim Bogor. Lap. Masalah Khusus. Jurusan Agrometeorologi, Dept. Ilmu Pengetahuan Alam Fakultas Pertanian IPB, Bogor, 120p. Unpublished.
- Sunjaya, P.I. 1970. Dasar-dasar ekologi serangga. Diktat, Bagian Ilmu Hama Tanaman Pertanian Institut Pertanian Bogor, Bogor, 135p. Unpublished.
- Wigglesworth, V.B. 1974. Insect Physiology. 7th ed. Chapman & Hall, London, 165p.