

**MORPHOLOGICAL COMPARISON OF THREE ASIAN NATIVE  
HONEY BEES (*APIS CERANA*, *A. DORSATA*, *A. FLOREA*)  
IN NORTHERN VIETNAM AND THAILAND**

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**ABSTRACT**

Three species of Asian native honey bees (*Apis cerana*, *A. florea* and *A. dorsata*) from northern Vietnam and Thailand were morphologically analyzed for investigations on their geographic variations and relations. In Vietnam, samples were collected from feral and managed colonies. In Thailand, the collections were from feral colonies or from field bees on flowers. Morphological analysis was carried out, using measurements common to honeybee taxonomy. Measured characters were done under stereomicroscope with an ocular micrometer. ANOVA program and multivariate statistical analyses were applied for treating the data. Overall, *A. cerana* populations in northern Vietnam are significantly morphologically different than from those in Thailand. It may be due to their different geographic locations between the Thai and Vietnamese populations of *A. cerana*. *A. florea* bees from Vietnam are generally bigger in size than those from Thailand, but the differences are uncertain. In contrast, the body size of *A. dorsata* populations from Thailand are bigger than those from Vietnam. However, these differences are also not significant. It is necessary to take further comparative investigations of these bee species from both countries.

Key words: Honey bee/*Apis cerana*/*Apis dorsata*/*Apis florea*/morphology

**INTRODUCTION**

In the genus *Apis*, eastern honey bees (*Apis cerana*), giant honey bees (*Apis dorsata*), and dwarf honey bees (*Apis florea* and *Apis andreniformis*) are native to many countries in Southeast Asia. These bee species play an important role in producing large amount of valuable products for people and in pollinating agricultural crops. However, their value is not well documented. The studies of their biological and economic characteristics being useful for strains improvement are less than those of European honey bees (*A. mellifera*).

A few publications relate to geographical variations and distribution of these honey bee species in different parts of Southeast Asia. Ruttner (1988) reviewed the geographical distribution of *A. dorsata*, *A. cerana*, *A. florea* in Asia. Verma (1990) made an extensive investigation on the distributions of *A. cerana* in India. Peng *et al.* (1989) reviewed studies on the biology and distribution of races of *A. cerana* in China. A morphological analysis of *A. cerana* and *A. nigrocincta* populations from Southeast Asia has been taken by Damus and Otis (1997). Rinderer *et al.* (1995) published data on comparative morphology of the dwarf honey bees in Southeast Thailand and Palawan, Philippines. Wongsiri *et al.* (1993) carried out a comparative investigation of some biological characteristics of *A. cerana* bees in China, Thailand and their hybrids for the purpose of using biological measures to control *Varroa* parasitic mites.

Therefore, at present, there is a big gap in information on the genetic biodiversity of Asian native honey bees. It is not clear how many subspecies and ecotypes of these native bee species exist in Southeast Asia and how they are related to each other.

The purpose of this paper is to present some preliminary results on comparative morphology of the three honey bee species: *A. cerana*, *A. florea* and *A. dorsata* in Vietnam and Thailand to contribute basic information on certain morphological parameters.

### MATERIALS AND METHODS

In Vietnam, samples of the three honey bee species were collected from locations of four provinces in the North (Haiphong, Laichau, Hoabinh, Nghean). At each location, four to six colonies were sampled. From each single colony, a sample of 40'-60 worker bees was collected.

In Thailand, *A. cerana* samples were collected in Bangkok, partly from a feral colony, partly from field bees on flowers in the gardens. *A. florea* bees were also collected on flowers. *A. dorsata* bees were sampled in Nan Province by using high voltage light trap to attract the bees from 14 colonies in one tree to the light. This sample should contain bee individuals from different colonies.

The sampled bees were killed with hot water (around 90°C) to obtain their stretched proboscis, then they were preserved in 70% ethanol. Thirty worker bees of each location (five to ten bees per sample) were selected and analyzed morphologically on temporary slide preparations. The following morphological measurements were recorded:

- |                        |   |
|------------------------|---|
| 1. Length of proboscis | 8. Length of basitarsus                   |
| 2. Width of prementum  | 9. Width of basitarsus                    |
| 3. Length of forewing  | 10. Tergite 3, longitudinal               |
| 4. Width of forewing   | 11. Tergite 3, transverse                 |
| 5. Cubital index       | 12. Sternite 3, longitudinal              |
| 6. Length of femur     | 13. Sternite 3, transverse                |
| 7. Length of tibia     | 14. Wax plate of sternite 3, longitudinal |
|                        | 15. Wax plate of sternite 3, transverse   |

The measurement was done according to the Ruttner's methods (1988), using a stereomicroscope with an ocular micrometer. For most parts, numbers presenting lengths or widths of various structures are in millimeters.

The data were analyzed using ANOVA program, and the Student's t test was used to test the null hypothesis from the two equal sources of data. A clustering analysis was also applied to analyze the relationship between two honey bee populations, and establish their tree diagrams.

## RESULTS

The results of morphometric measurements from these honey bee species are presented in Table 1. The results show that the body size of *A. cerana* in Vietnam was bigger than that in Thailand. Of the 15 measured characters, the values of 11 characters were significantly bigger (1, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14) particularly the cubital index, while the width of prementum and forewing were smaller.

The body size of *A. florea* in Vietnam was also bigger than those from Thailand. However, these differences were not clear. Six characters (3, 4, 5, 6, 12, 14) of the bees from Vietnam were significantly larger than those from Thailand. The remaining characters were slightly larger (10, 13), equal (2,7,9, 15) or smaller (1, 8, 11). In contrary to *A. cerana* and *A. florea*, the body size of *A. dorsata* in Thailand was bigger than those from Vietnam. Of 15 measured characters, the value of 11 characters of *A. dorsata* in Thailand were higher (2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15), one character was equal (10) and three characters were smaller (1, 9, 13). Interestingly, while the cubital index of *A. cerana* and *A. florea* in Thailand were significantly bigger than those in Vietnam, this character in *A. dorsata* of both countries was not significantly different.

## DISCUSSIONS

The differences in body parts between *A. cerana* populations from Vietnam and Thailand are reasonably significant. Twelve larger measured characters of *A. cerana* in Vietnam indicate that these two honey bee populations may be considered as separating geographical groups. According to Ruttner (1988), the characters that can be considered to distinguish bee populations into subspecies levels are lengths of basitarsus, tergite 4, sternite 3, wax plate transverse of sternite 3, and cubital index. In this study, all these characters are significantly different between the two populations. The tree linkage diagram analysis (Figure 1-a) shows the bee population in Vietnam is also clearly distinguished from that in Thailand. All the Vietnamese bee populations are ranged in a distinct group (from 1 to 15) separated from the Thai group (from 16 to 30) and there is no overlap between them.

Our data support the Ruttner's (1988) statement that *A. cerana* can be distinguished into two subspecies: *A. cerana cerana* and *A. cerana indica*. The former includes the bees of Vietnam, Afghanistan, Pakistan, North India and China. The later includes the bees of Thailand, Malaysia, Myanmar, Bangladesh, Sri Lanka and South India, Indonesia, Philippines. Comparing these results to the data of Peng *et al.* (1989) and Verma (1990), it is recognized that the *A. cerana* bees from Vietnam are closer to the bees in Southern Yunnan (China) and Nepal, while *A. cerana* bees from Thailand are closer to the bees in Southern India.

Table 1. A comparison of morphometric characteristics of honey bee species from Vietnam and Thailand.

| Character                            | <i>Apis cerana</i> |             | <i>Apis florea</i> |             | <i>Apis dorsata</i> |             |
|--------------------------------------|--------------------|-------------|--------------------|-------------|---------------------|-------------|
|                                      | Vietnam            | Thailand    | Vietnam            | Thailand    | Vietnam             | Thailand    |
| 1 Length of proboscis (mm)           | 4.91±0.017         | 4.82±0.029  | 3.45±0.026         | 3.57±0.020  | 6.56±0.032          | 6.54±0.022  |
| 2 Width of prementum (mm)            | 0.73±0.006         | 0.73±0.005  | 0.56±0.007         | 0.56±0.007  | 0.83±0.037          | 0.91±0.007  |
| 3 Length of forewing (mm)            | 8.16±0.027         | 7.93±0.032  | 6.76±0.034         | 6.11±0.117  | 12.96±0.044         | 13.14±0.041 |
| 4 Width of forewing (mm)             | 2.83±0.011         | 2.78±0.016  | 2.31±0.010         | 2.24±0.009  | 4.47±0.012          | 4.55±0.016  |
| 5 Cubital index                      | 3.492±0.099        | 2.973±0.125 | 3.57±0.198         | 2.802±0.079 | 6.750±0.239         | 7.172±0.253 |
| 6 Length of femur (mm)               | 2.32±0.099         | 2.31±0.007  | 1.27±0.009         | 1.66±0.008  | 3.23±0.008          | 3.26±0.008  |
| 7 Length of tibia (mm)               | 2.86±0.009         | 2.87±0.014  | 2.19±0.009         | 2.19±0.008  | 4.19±0.015          | 4.25±0.010  |
| 8 Length of basitarsus (mm)          | 1.82±0.008         | 1.72±0.007  | 1.36±0.006         | 1.37±0.008  | 2.96±0.013          | 2.99±0.015  |
| 9 Width of basitarsus (mm)           | 1.03±0.006         | 1.00±0.007  | 0.66±0.006         | 0.66±0.006  | 1.39±0.007          | 1.33±0.012  |
| 10 Tergite 3, longitudinal (mm)      | 8.37±0.033         | 8.02±0.025  | 5.90±0.028         | 5.88±0.024  | 10.25±0.034         | 10.25±0.031 |
| 11 Tergite 3, transverse (mm)        | 1.78±0.008         | 1.68±0.007  | 1.34±0.007         | 1.36±0.009  | 2.82±0.011          | 2.88±0.030  |
| 12 Sternite 3, longitudinal (mm)     | 4.68±0.016         | 4.41±0.017  | 3.06±0.013         | 3.01±0.015  | 5.59±0.016          | 5.75±0.019  |
| 13 Sternite 3, transverse (mm)       | 2.09±0.008         | 2.04±0.019  | 1.67±0.008         | 1.66±0.009  | 3.82±0.018          | 3.76±0.012  |
| 14 Wax plate of ster. 3, longi. (mm) | 2.02±0.008         | 1.91±0.012  | 1.38±0.008         | 1.28±0.007  | 2.57±0.009          | 2.61±0.015  |
| 15 Wax plate of ster. 3, trans. (mm) | 1.02±0.006         | 1.02±0.007  | 0.76±0.013         | 0.75±0.008  | 1.69±0.009          | 1.70±0.011  |

\*\* : Significant difference at  $P \leq 0.01$ , \* : Significant difference at  $P \leq 0.05$ , ns : Non significant difference.

Morphological comparison of three Asian native honey bees – N.V. Niem & L.Q. Trung

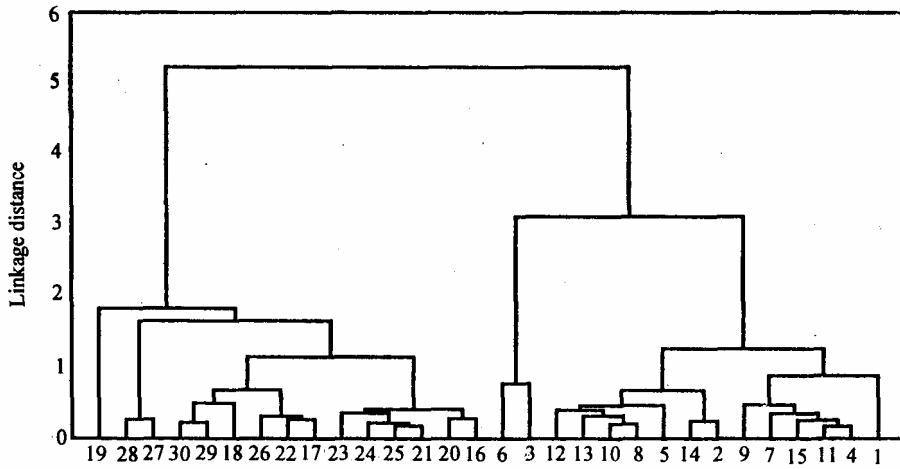


Figure 1a. Tree linkage diagram of *Apis cerana* bee populations from Northern Vietnam (1-15) and Thailand (16-30).

Overall, the body size of *A. florea* from Vietnam is slightly bigger than those from Thailand. However, the differences between these bee populations are too small to consider them as different ecotypes. The tree diagram (Figure 1-b) shows an overlap between these two populations. Therefore, it is necessary to take further studies on the relationship of these bee populations between Vietnam and Thailand.

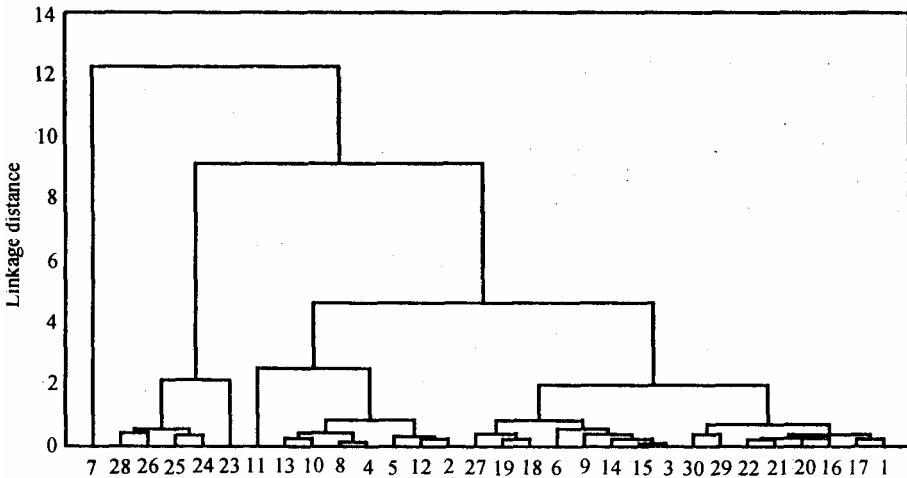


Figure 1b. Tree linkage diagram of *Apis florea* bee populations from Northern Vietnam (1-15) and Thailand (16-30).

Contrary to *A. cerana* and *A. florea*, *A. dorsata* bees in Thailand are bigger in body size than those in Vietnam, but the differences of the measured characters and the tree diagram analysis (Figure 1-c) could not support any distinction at the species levels between these two bee populations.

Regarding the giant honey bees (*A. dorsata*), Maa (1953) created a genus *Megapis* with four species: *Megapis breviligula*, *M. binghami*, *M. dorsata* and *M. laboriosa*. On the other hand, Ruttner (1988) stated that there is very little evidence to support the idea of distinguishing *A. dorsata* into different subspecies, although its distribution is in a large range of the Southeast Asian region. However, according to his opinion, *A. dorsata* in this area can be separated only into two subspecies: *A. d. breviligula* and *A. d. binghami*. In this study, the differences in morphological characteristics of *A. dorsata* populations from Vietnam and Thailand are rather low to make any conclusion at the species level of classification.

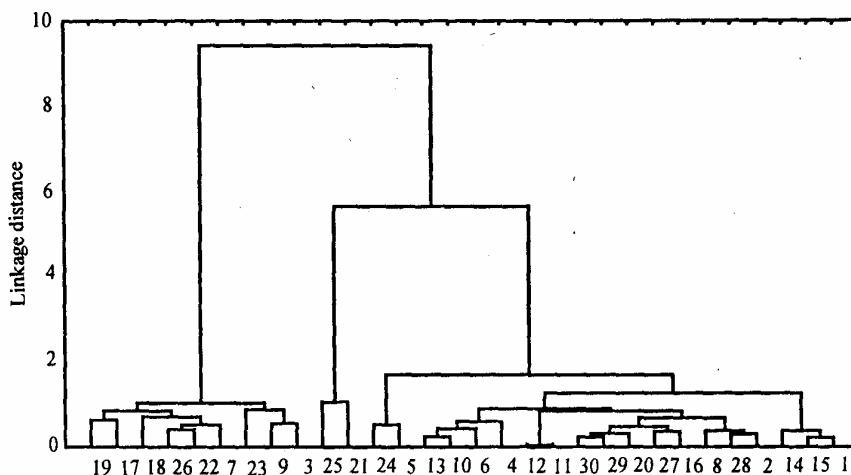


Figure 1c. Tree linkage diagram of *Apis dorsata* bee populations from Northern Vietnam (1-15) and Thailand (16-30).

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