

Scanning Electron Microscopic Observations on the Surface Structure of the Tick *Boophilus microplus* (Canestrini, 1887) Female Specimens

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INTRODUCTION

The tick *Boophilus microplus* (Canestrini, 1887) (Acarina: Ixodidae) is one-host tick, only species of the genus *Boophilus* and one of the most predominant ticks, next to *Haemaphysalis longicornis*, attacking cattle in the Republic of Korea (Kang, 1982 & 1984b; Kang & Jang, 1984).

For a long time this species has been called by the names of *Boophilus annulatus caudatus* Tokishige, 1911, *B. caudatus* Minning, 1934, *Haemaphysalis micropla* Canestrini, 1887, *Margaropus annulatus australis* Sugimoto, 1936, *M. a. caudatus* Sugimoto, 1937, *Palpoboophilus brachyuris* Kishida, 1939, *P. minningi* Kishida, 1936, *Rhipicephalus annulatus caudatus* Neumann, 1897, *Uroboophilus australis* Fuller, 1899, *U. caudatus* Kishida, 1939, *U. sharifi* Minningi, 1934, and *U. sinensis* Minning, 1934, in the Japanese literature (Kishida, 1936; Sugimoto, 1937 a & b; Kitaoka & Yajima, 1958) referring to the specimens from Japan, Taiwan and Korea. However, Yamaguti *et al.* (1971) accepted the opinions of Anastos (1950) and Hoogstraal (1956) for the classification and identification of the species of *Boophilus* ticks and regarded *B. microplus* is the only species to occur in the east Asian countries.

Recently, Kang (1984b) reviewed on the ticks and tick-borne diseases in Korea and

showed the distribution of the tick species occurring in the Korean Peninsula and on Cheju Island, while Minami (1984) reviewed on the ticks and tick-borne diseases in Japan and mentioned that *B. microplus* is the proven vector of *Babesia bigemina* and *B. bovis* for bovine babesioses in Okinawa, Japan.

Authors have tried to observe the fine surface structures of the ectoparasites such as ticks, mites, lice, fleas, flies and mosquitoes. The pictorial reports with scanning electron microscopy on the cattle tick *Haemaphysalis longicornis* (Kang and Jang, 1984), the kennel tick *Rhipicephalus sanguineus* (Kang, 1984a) and the lice *Cuclotogaster heterographus* and *Anaticola anseris* collected from the white stork *Ciconia boyciana* (Kang and Byun, 1984) have been presented already, and other papers are waiting for publication.

In this report, the scanning electron microphotographs of the tick *B. microplus* female specimens were provided for the understanding of fine surface structures in the legs, capituli, female genital organ, anus and setae. The findings obtained were compared with the opinions and descriptions already presented elsewhere (Anon., 1974a & b; Kang, 1984a & b; Kang and Jang, 1984; Stendel and Holm, 1975).

MATERIALS AND METHODS

Tick specimens: During the period from 1982

to 1984, numerous tick specimens were collected from the host animals and their environments in the nation-wide survey and classified for identification of the species (Kang, 1982 & 1984b). The specimens of *B. microplus* identified already were originally collected from cattle in the areas of Kumsan, Yunki, Daeduk, Kongju and Buyeo in Chungchong-Nam-Do, Jangsu and Namwon in Cholla-Puk-Do, and Jinju in Kyungsang-Nam-Do. They were preserved and fixed in 10% formol-saline or 70% ethyl alcohol containing 10% glycerine.

Scanning electron microscopy: The procedures of scanning electron microscopy were exactly the same as shown in the former presentations (Kang, 1984a, Kang & Jang, 1984, and Kang & Byun, 1984). Drying was performed in the air approximately at 30°C and it was confirmed that air drying was sufficient for the chitinous specimens (Stendel & Holm, 1975). The fairly well dried specimens were then easily fixed on the stubs by means of both-sided serotapes or paste specially formulated for scanning electron microscopy. Finally, the specimens were subjected to evaporation with gold (Au) by an ion-coator. For the observation of the coated specimens a scanning electron microscope (Model; SEM ISI-DS-130) manufactured by Korea I.S.I. Co. Ltd. was applied. For microphotography the Kodak polaroid films were used at 10 to 30 kilovolts with the range of 12.2× to 5,000× magnifications. The magnification and measurement scales were automatically determined by the ratio of the screen to that of the scanned specimens. In this report, the figures numbered 1, 2, 7, 8, 11 and 12 were slightly enlarged and trimmed for duplication from the original photographs.

RESULTS

Description of the female specimens: The body was inornate. The scutum was reverse pentagonal shape and the eyes were present but concaved and faint (Figs. 1 and 3). The spiracular plate was round shape and situated posterolaterally to coxa IV (Fig. 1). The joints

on the legs were connected smoothly but not specified (Fig. 2). The anal grooves and festoons were absent. There were finger prints on the body surface and the coxa I was bifid (Fig. 2). The scutal punctations were indistinct (Fig. 3). There were two types of setae on the body surface and appendages (Figs. 3, 4, 11 and 12). The palpi were wider than long and compressed, ridged dorsally and laterally. There were usually four pairs of ventrointernal setae on the articles (Fig. 5). The hypostome dentition was usually 4/4 but occasionally 5/5 (Fig. 6).

The basis capitulum was hexagonal dorsally (Fig. 7), and the porose area was distinct with the holes developed well (Fig. 8). The genital organ was situated on the level with coxa II and there were numerous folds resembling finger prints around the genital pore and the folds were focussed to the genital pore (Fig. 9). The anus was located ventrally at 1/4 of the hind part of the body and highly developed. There were distinct fold-like structures around the anal pore outside and a pair of lobe-like structures inside. A pair of specific setae was also seen on the anal lobes (Fig. 10).

DISCUSSION

Yamaguti *et al.* (1971) agreed that there are only four valid species in the genus *Boophilus* in the world, such as *B. microplus*, *B. decoloratus*, *B. annulatus* and *B. kohlsi* in accordance with the opinions of Anastos (1950), Arthur (1960), Hoogstraal (1956) and Hoogstraal and Kaiser (1971). However, it has been known that another valid species, *B. calcaratus* occurs in the U.S.S.R. (Kuklina, 1967). The descriptions presented by Hoogstraal (1956), Arthur (1960), Roberts (1970) and Yamaguti *et al.* (1971) were extremely helpful for the classification and identification of the tick species although their descriptions were based on conventional microscopy and hand-drawings. Using the scanning electron microscope, the identification and diagnosis for ticks are much easily confirmed by morphological characteristics. Using scanning

electron microscopy, the specimens are always seen in three dimensions and the measurements are determined automatically, so that the findings are recognized to be most useful for the identification and diagnosis of the tick specimens having fine differential morphological characteristics.

Kitaoka and Yajima (1958) reported already a series of physiological studies on the present tick species in Japan, while Hitchcock (1955) reported the ecological properties in Australia. Although some literature have presented laboratory colonization data for *B. microplus* fed on the laboratory animals including rabbits, it is recognized that mass production of the species is absolutely difficult by means of laboratory feeding on other animals beside bovines. Gregson (1966) reviewed on the tick colonization and mass production in the laboratory.

Yamaguti *et al.* (1971) described on the disease relationship of *B. microplus* and mentioned that this species is one of the most important pests of cattle, and a vector of organisms pathogenic to domestic animals in America, Asia and Australia, in relation to the agents, *Anaplasma marginale*, *Babesia bigemina*, *B. berbera*, *B. ovis*, *etc.* On the other hand, Han (1968) tried a transmission experiment of so-called small type piroplasmiasis (*Theileria sergenti*, in fact) with the ticks *Haemaphysalis longicornis* and *B. microplus*, and reported that the proven vector of the protozoan agent was *H. longicornis* (as *H. bispinosa*) and not *B. microplus*. Han *et al.* (1966) also reported that the population of *B. microplus* was highest in mid-1960s in Korea, however the data obtained recently (Kang, 1982) revealed that *Haemaphysalis longicornis* is currently the most predominant tick species throughout the nation.

B. microplus has often been used as a subject for tests on acaricidal efficacy of pesticides, especially for the resistance experiments on the Australian strains (Wharton *et al.*, 1970; Wilson *et al.*, 1971) because this species has been regarded to get resistance to acaricides easily (Graham and Hourrigan, 1977). It is

also notifiable that this species has been used for the experiments with newly developed synthetic pyrethroids (Don & Pulga, 1985; Hopkins *et al.*, 1985; Sosa, 1985).

SUMMARY

Boophilus microplus (Canestrini, 1887) female specimens were subjected to scanning electron microscopy for the observation of surface fine structures. Morphological characteristics observed were summarized as follows:

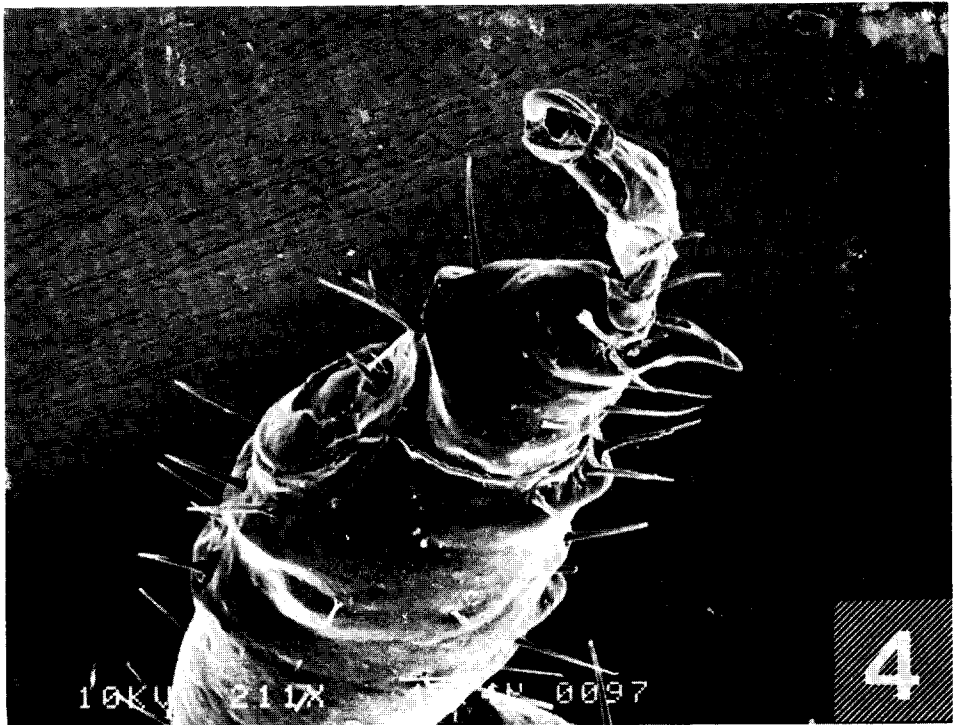
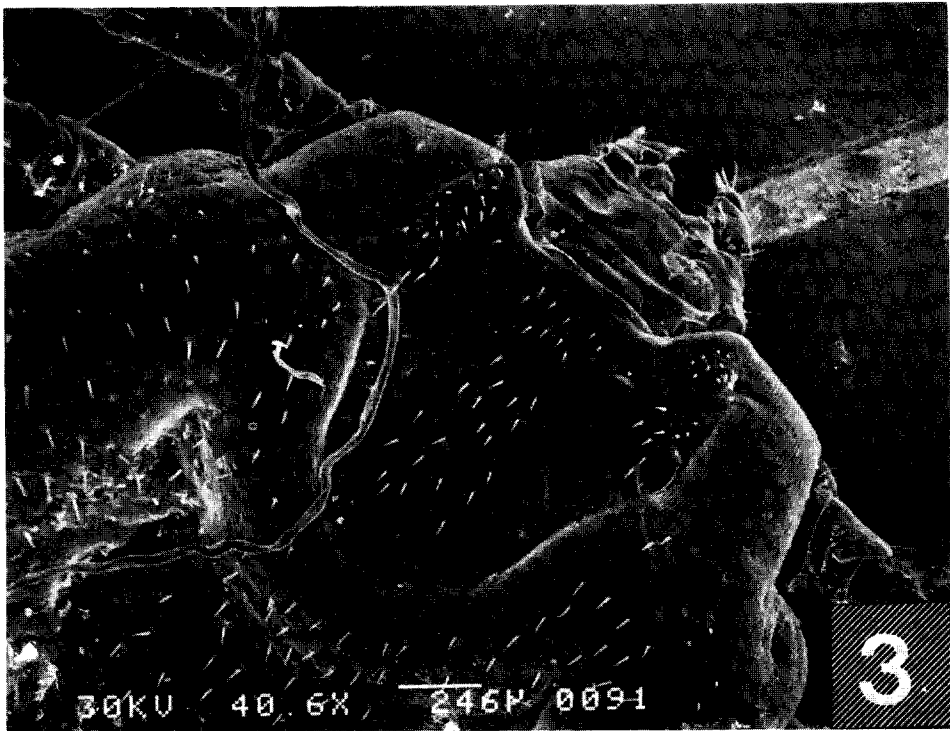
1. The palpi were wider than long, and compressed, ridged dorsally and laterally. There were usually four pairs of ventro-internal setae on the articles.
2. The hypostome dentition was usually 4/4 but occasionally 5/5.
3. The basis capituli were hexagonal dorsally and the porose area was distinct with the holes developed well.
4. There were numerous folds resembling finger prints around the female genital pore.
5. A pair of anal lobes with specified setae on them was also recognized as one of the morphological characteristics.

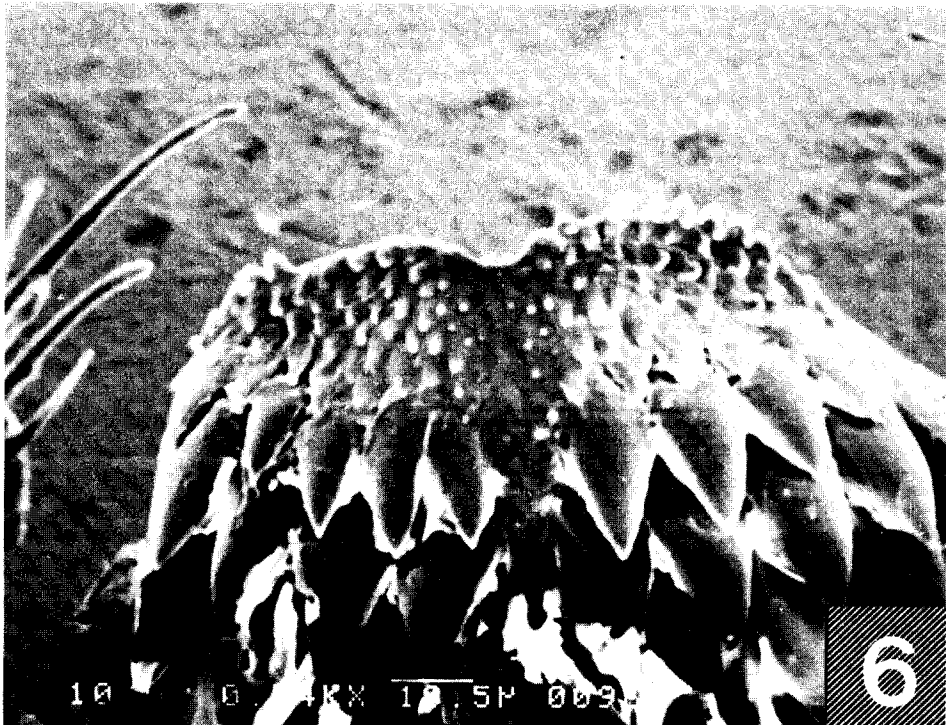
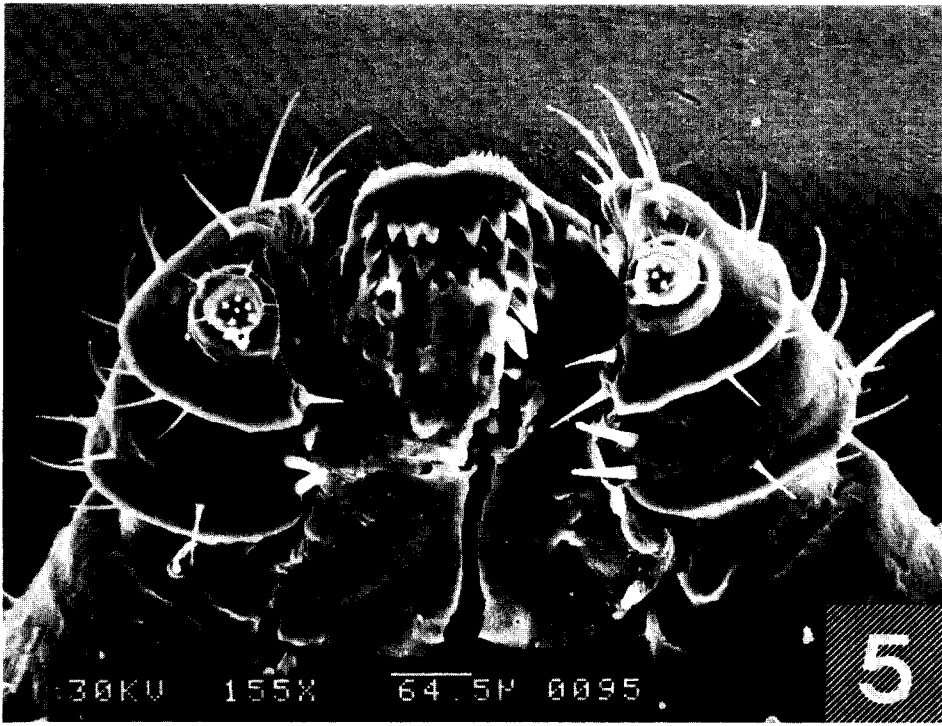
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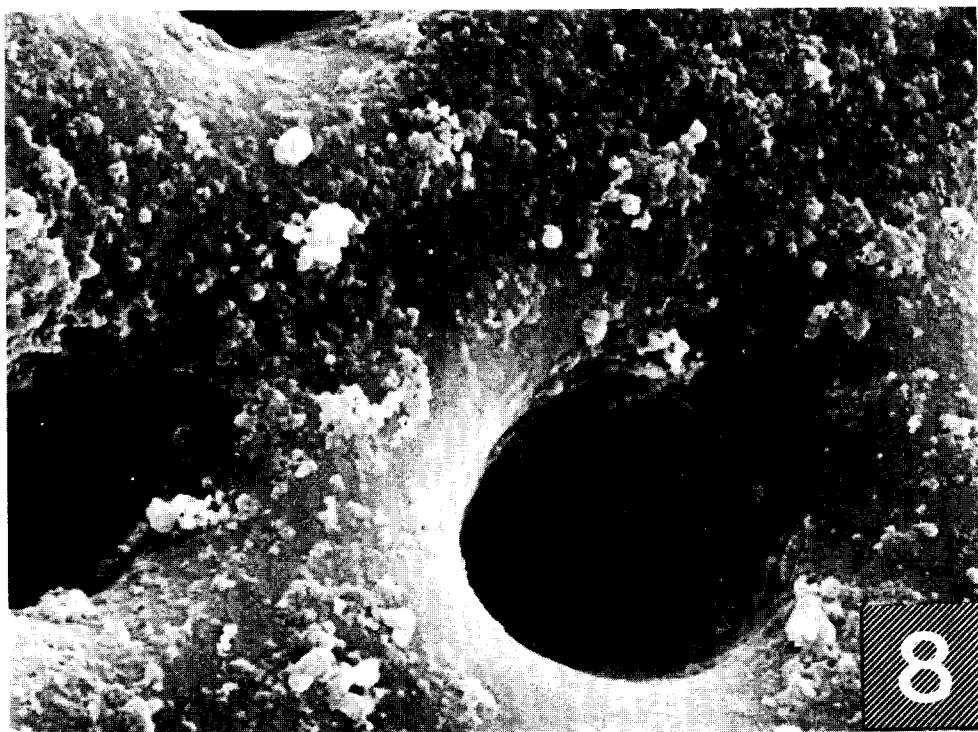
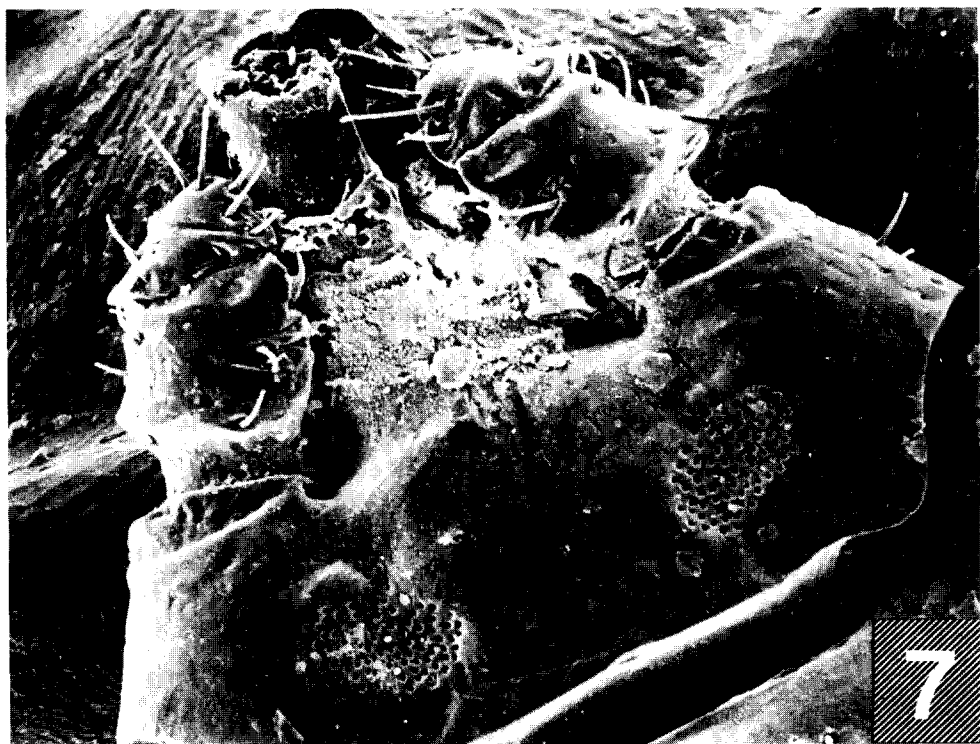
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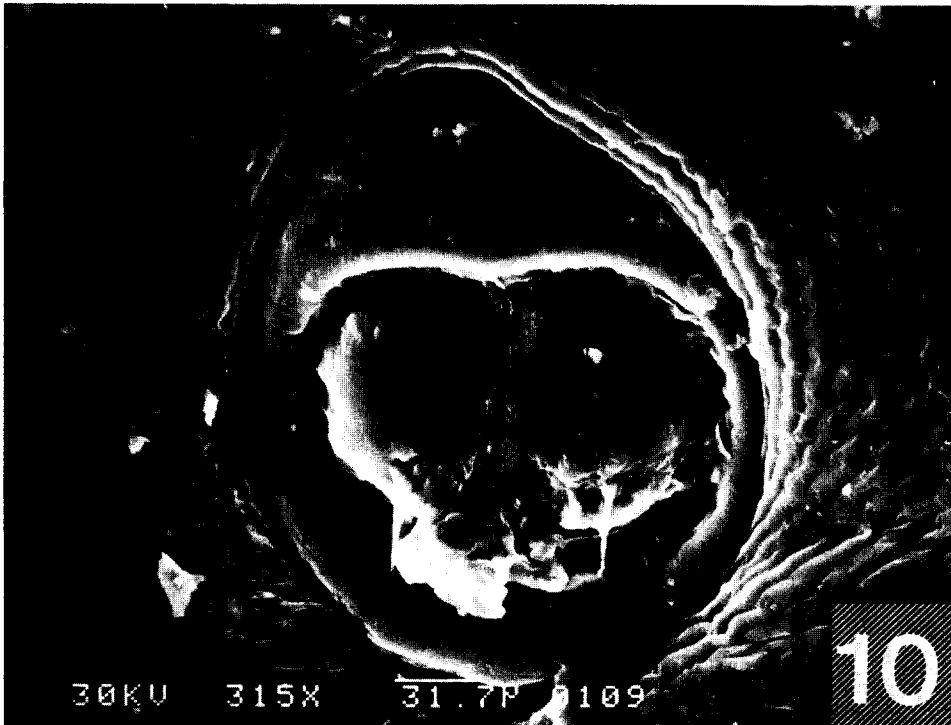
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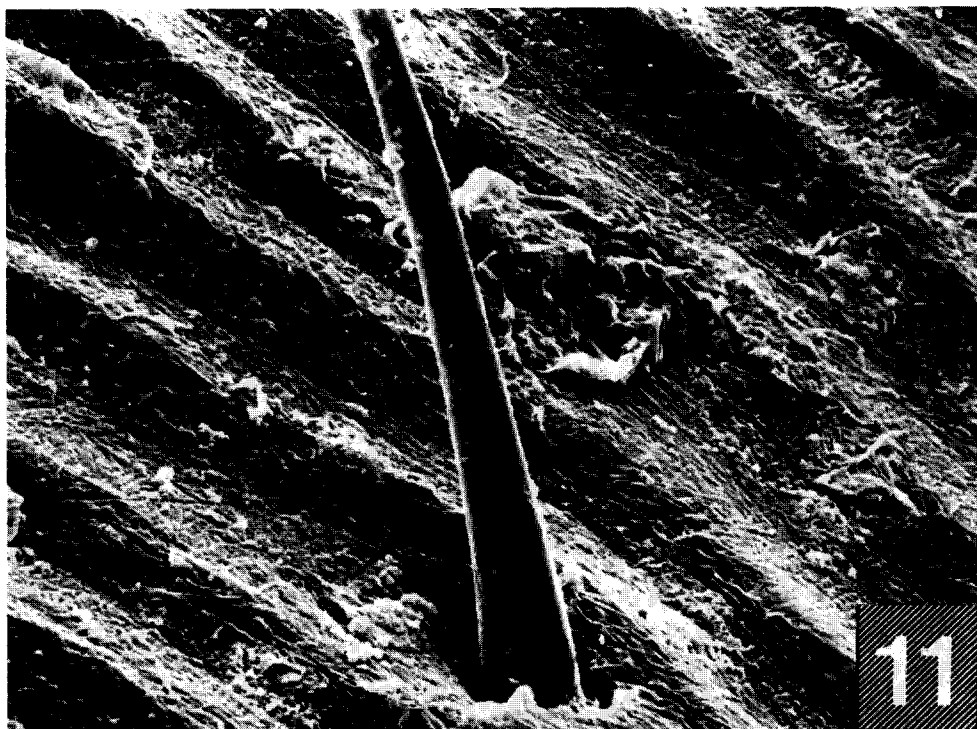












走査電子顯微鏡 映像分析에 의한 *Boophilus microplus* 雌蟲의 表面 微細構造

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우리나라 소와 양에 많이 寄生 分布하고 있는 *Boophilus microplus* 진드기의 암놈 成蟲에 對한 表面 微細構造를 觀察해 보고자 走査電子顯微鏡(Model; SEM ISI-DS-130)을 使用하였으며, 映像觀察 및 寫眞分析 結果 얻어진 形態學的 特徵을 要約하면 다음과 같다.

1. 觸鬚는 길이보다 幅이 넓으며, 前後方으로는 短縮되고, 背側方으로는 융기되어 있는 모습을 나타낸다. 觸肢에는 흔히 4雙의 腹內側 剛毛를 가지고 있다.
2. 齒列에 있어서의 齒式은 大部分 4/4로 表記 되지만 때때로 5/5를 보이는 경우도 있다.
3. 口下片은 背方으로 向한 六角型 모양을 나타내며 잘 發達된 多孔域을 볼 수 있다.
4. 雌蟲 成蟲의 生殖器 주변에 生殖孔을 向하여 펼쳐져 있는 脂紋樣의 수많은 주름을 볼 수 있다.
5. 肛門에 있어서는 잘 發達된 剛毛 1個씩을 가지고 있는 1雙의 肛門內葉을 特徵적으로 觀察할 수 있었다.

LEGENDS FOR FIGURES

Boophilus microplus (Canestrini, 1887) female specimen. Scanning Electron Microscope (SEM ISI-D-130, 10 to 30 KV).

- Fig. 1.** Dorsolateral view of the engorged female, showing the mouth part, scutum, 4 legs and spiracular plate. (12.2×)
- Fig. 2.** Ventrolateral view showing the finger prints on the body surface and the legs II and III with some setae, (50×)
- Fig. 3.** Dorsal view showing the basis capitulum with porose area and the setae on the scutum. (40.6×)
- Fig. 4.** The magnified tarsus with pulvillus and claw showing the Haller's organ and some setae. (211×)
- Fig. 5.** Ventral view of the capitulum showing the hypostome, aricles with ventrointernal setae, corona and files. Hypostome dentition 4/4 or 5/5. (155×)
- Fig. 6.** Ventral aspect of the hypostome with the magnified corona files. (540×)
- Fig. 7.** Dorsal view of the capitulum, showing the pedipalps with setae, hypostome and the porose areas on the basis capitulum. (100×)
- Fig. 8.** The highly magnified porose area holes. (5,000×)
- Fig. 9.** The magnified genital organ showing the setae and folds resembling finger prints. (315×)
- Fig. 10.** The magnified anus showing the anal lobes with specified setae. (315×)
- Fig. 11.** A setae on the surface of the abdomen with high magnification. (1,000×)
- Fig. 12.** A setae on the surface of the trochanter with high magnification. (1,500×)