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MORPHOLOGICAL VARIATION IN ADULT FEMALE *COCCUS HESPERIDUM* L. (HEMIPTERA: COCCOIDEA: COCCIDAE) IN POLAND.

ABSTRACT

MORPHOLOGICAL VARIATION IN ADULT FEMALE *COCCUS HESPERIDUM* L. (HEMIPTERA: COCCOIDEA: COCCIDAE) IN POLAND.

This paper compares the variation of ten morphological characters of adult female *C. hesperidum* L. collected off (i) five different host plants and (ii) the stems, petioles and both leaf surfaces of *Citrus*, all from glasshouses in Poland. Four measured and six meristic characters were selected for biometric study. The mean and range of each of these characters varied between host plant species and with their position on *Citrus*. The main characters which varied between host species were the size and shape of the dorsal setae and the distribution and frequency of dorsal and ventral tubular ducts. Specimens off different parts of *Citrus* varied mainly in the frequency of the dorsal tubular ducts and the spiracular disc-pores. Pocket-like sclerotisations were noted for the first time in *C. hesperidum*; when present, they were in the stigmatic areas, close to a dorsal tubercle.

Key words: brown soft scale, *Citrus limon*, *Ficus benjamina*, *Hedera helix*, *Iresine herbstii*, *Schefflera actinophylla*, dorsal tubercles, host-induced differences.

INTRODUCTION

The brown soft scale is a cosmopolitan species, occurring outdoors in the tropics and subtropics, but more or less restricted to greenhouses in less temperate regions. In Poland, it is a serious pest of many ornamental pot plants.

Morphological variation in *C. hesperidum* has been observed by many authors but, so far, only variation in the shape and the size of the body and in parts of antennae and legs have been examined in detail (Fonseca, 1953; Blair *et al.*, 1964). Hodgson (1967) suggested that some morphological variation in this species might be correlated with its position on the host plant.

The present study was undertaken to investigate the variation of some morphological characters of adult female *C. hesperidum*, depending on (i) the host plant species and (ii) their position on the host plant.

MATERIALS AND METHODS

Adult female *C. hesperidum* were collected from ornamental pot plants

(*Citrus limon*, *Ficus benjamina*, *Hedera helix*, *Iresine herbstii* and *Schefflera actinophylla*) reared in greenhouses. A total of 439 adult females were examined on microscopic slides: 186 off *Citrus*, 93 off *Ficus*, 30 off *Hedera*, 30 off *Iresine* and 100 off *Schefflera*. On *Citrus*, the samples from stems, petioles and the upper and lower leaf surfaces were analysed separately. The measurements of slide-mounted specimens were made using a Carl Zeiss Jenamed 2 Histology Microscope with an ocular micrometer (magnifications 10x and 400x). The characters studied, the number of measurements and the means and ranges of the values for each feature are listed in Tables 1 and 2.

RESULTS

Variation of morphological characters in *C. hesperidum* off different host plant species:

The means and ranges for the characters for specimens collected off the five different host plant species are presented in Table 1. The largest mean values were noted for specimens off *Ficus* (length and width of body) and off *Citrus* (length of antenna and length of trochanter + femur). In the sample off *Iresine*, the mean values of all measured characters were the smallest in comparison with those from the other host species.

Dorsal tubercles were present on all adult females examined and the mean values for this character were similar on all the samples studied, 6 and 7 being the most frequent total number present.

Pocket-like sclerotisations were also found on 92-100% of specimens collected off *Citrus*, *Ficus*, *Hedera* and *Schefflera,* where they were always present in the stigmatic areas, close to dorsal tubercles (Fig. 1). Only on a few specimens was this feature noted in the absence of dorsal tubercles. Pocket-like sclerotisations have not been previously noted on *C. hesperidum*. For further comment see under Discussion below.

Dorsal setae varied considerably in shape and size within each sample. Generally, on the samples from *Citrus*, *Hedera*, *Ficus* and *Schefflera*, the setae had bluntly pointed apices and were between 5-6µm long. However, those off *Iresine* were always sharply pointed and were 7.5-10µm long.

The dorsal and ventral tubular ducts were also highly variable in number and distribution. The greatest number of dorsal tubular ducts (19) was noted on specimens off *Schefflera*, while dorsal tubular ducts were never noted on specimens off *Iresine*. Most specimens off *Citrus* had a total of 1-3 dorsal ducts while 4-6 dorsal ducts were usually present on the other hosts. With regard to the ventral tubular ducts, the greatest number was on specimens off

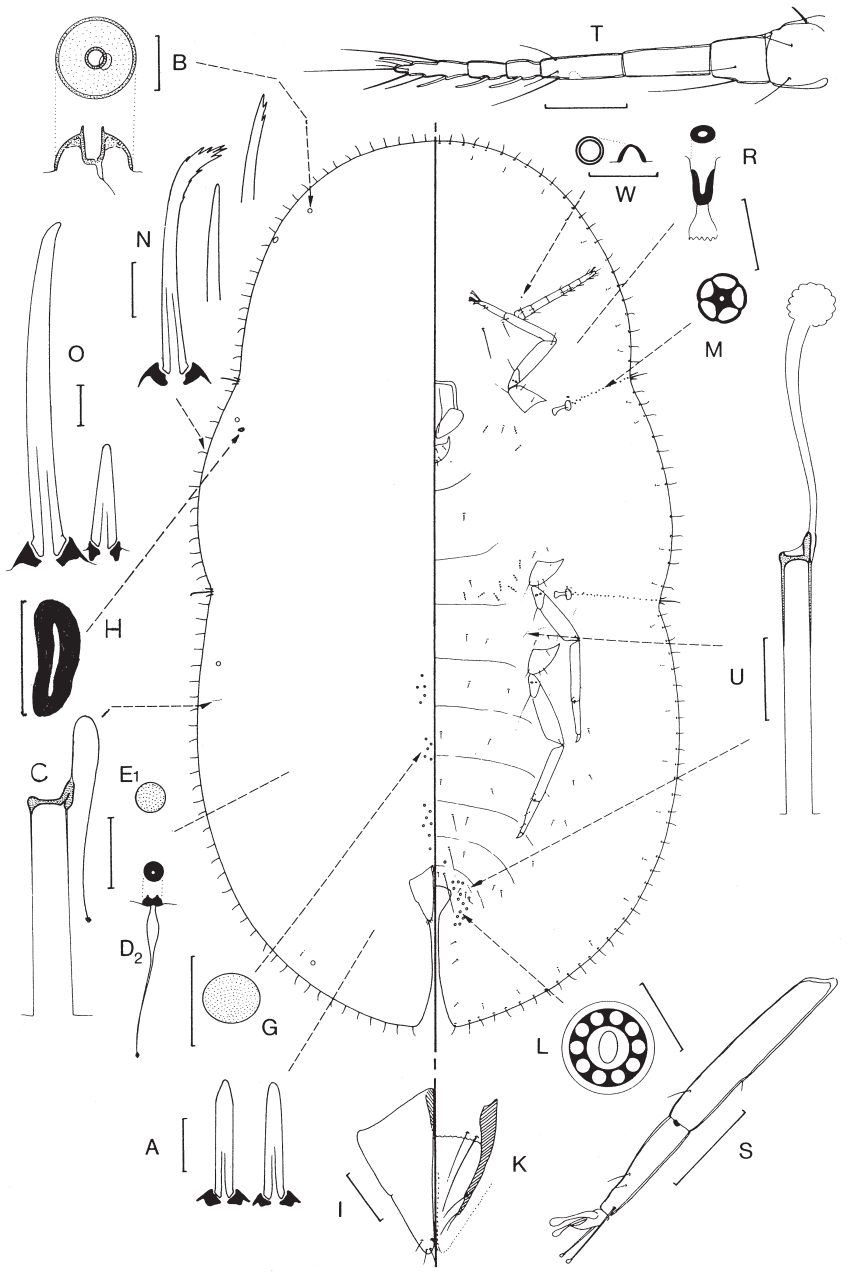

Fig. 1. Adult female *Coccus hesperidum*; showing position of pocket-like sclerotisation (H): scale line for H = 5µm.

Table 1. Means and ranges of ten characters of adult female *Coccus hesperidum* L. collected off five different host plant species:

Character	Hosts														
	Citrus			*Ficus*			*Hedera*			*Ivestus*			*Schefflera*		
	n	Mean	Range	n	Mean	Range	n	Mean	Range	n	Mean	Range	n	Mean	Range
Body length (µm)	184	2295	1400-4000	93	2988	1250-4550	29	2747	1650-3600	30	1895	1350-3060	100	2255	1380-3240
Body width (µm)	188	1295	640-2300	93	1627	570-2550	30	1710	900-2520	30	944	600-1350	100	1288	510-2400
Antenna length (µm)	163	307	170-390	85	286	230-320	29	278	210-310	30	261	220-322	99	284	235-342
Trochanter + femur length (µm)	184	166.6	125-200	88	162	140-185	30	162	145-180	30	148	125-170	100	159	130-200
Dors. tubular ducts: no	155	4.1	0-14	84	4.8	0-17	29	4.8	0-11	30	0	0	97	6.1	0-19
Dorsal tubercles: no	180	6.5	2-10	87	6.6	3-10	30	7.3	6-9	28	2-9	2-9	98	6.6	2-10
Spiracular disc-pores: posterior furrow: no	180	23.6	12-33	87	23.5	15-31	30	24.4	18-31	29	17-26	17-26	100	24.0	16-29
No. ventral tub. ducts:															
mesad to procoxa	166	1.7	0-6	87	2.0	0-5	29	1.4	0-4	30	0-3	0-3	97	2.0	0-7
mesad to metacoxa	167	5.9	0-14	86	7.4	2-17	30	3.3	1-7	30	0-9	0-9	96	6.2	2-14
intersegmental btwn meso- and metacoxa	168	2.7	0-7	88	3.7	1-9	30	1.1	0-4	30	0-6	0-6	95	2.3	0-10

Ficus (usually with a group of 7-9 mesad to each mesocoxa) and the least was on the specimens off *Hedera* (60% had only 1 to 3 ducts mesad to each mesocoxa). On the remaining material, the most frequent number mesad to each mesocoxa was 4-6.

The presence of ventral tubular ducts laterad to the metacoxa and to the genital opening was highly variable; females without these ducts were dominant on specimens off *Hedera*.

VARIATION OF MORPHOLOGICAL CHARACTERS OF FEMALE *C. HESPERIDUM* OFF DIFFERENT PARTS OF *CITRUS* PLANTS:

The means and ranges for each of the characters on specimens collected off four different parts of *Citrus limon* are shown in Table 2. This shows that the largest specimens (body length and width) were off the stems and petioles rather than off the leaves, although there was much overlap.

Only two meristic characters (number of dorsal tubular ducts and number of spiracular disc-pores in the posterior stigmatic furrow) varied depending on the position on the plant. Thus, specimens off the leaves tended to have more dorsal tubular ducts than those off the stems and petioles (means of 4.6 and 5.3 off the former as compared with 3.1 and 3.2 off the latter) and similarly with spiracular disc-pores (means of 24 and 25 as compared with 22). However, on all samples, dorsal tubular ducts were sometimes absent and the most common frequency was 1-3 ducts on each side. As regards the spiracular disc-pores, specimens off the petioles tended to have the least, usually having between 16 and 20. However, there was much overlap in both characters.

The presence of ventral tubular ducts laterad to the metacoxae and laterad to the genital opening was highly variable, but a single tubular duct was generally present near the genital opening, although a few specimens had two ducts.

DISCUSSION

This study shows that there is much variation in the structure of adult female *C. hesperidum*, depending on host plant species and on their position on the host.

Among the meristic characters studied, only the frequency of dorsal and ventral tubular ducts varied greatly between host plant species. Ventral tubular ducts were never found medially between the metathoracic legs, thus agreeing with the descriptions of this species by Hodgson (1967) and Gill *et*

Table 2. Means and ranges of ten characters of adult female *Coccus hesperidum* L. collected from four different parts of *Citrus*:

Characters	Plant parts											
	Stems			Petioles			Upper leaf surface			Lower leaf surface		
	n	Mean	Range	n	Mean	Range	n	Mean	Range	n	Mean	Range
Body length (μm)	54	2500	1700-4000	28	2373	1770-3150	42	2200	1400-2940	62	2145	1410-3090
Body width (μm)	33	1510	900-2300	29	1282	940-1650	45	1194	680-1980	61	1189	680-1760
Antenna length (μm)	50	308	255-350	24	302	240-340	56	299	262-365	33	314	250-390
Trochanter + femur length (μm)	54	166	140-180	28	164	125-185	42	163	150-180	60	167	140-200
Dorsal tubular ducts: no.	38	3.1	0-10	22	3.2	0-11	40	5.3	0-12	55	4.6	0-14
Dorsal tubercles: no.	53	6.4	2-10	26	6.5	4-9	41	6.5	4-10	60	6.6	3-10
Spiracular disc-pores in posterior furrow: no.	55	22.1	12-33	23	21.9	16-30	40	23.8	14-33	62	24.9	16-35
Ventral tubular ducts:												
mesad to procoxa: no.	52	1.7	0-5	21	1.5	1-3	39	1.8	0-4	54	1.7	0-6
mesad to mesocoxa: no.	48	5.9	2-11	21	5.8	4-9	40	5.9	3-9	58	5.9	0-14
intersegmental between meso- and metacoxa: no	47	2.7	1-7	22	2.7	1-4	40	2.5	0-5	59	2.9	0-6

al. (1977). On the material from Poland, the frequency of the dorsal tubular ducts ranged from 0-19 while, on specimens from North America, it ranged between 0-21 (Gill *et al.*, 1977).

Only two meristic characters (i.e., the number of dorsal tubular ducts and the number of spiracular disc-pores) varied according to the position of females on their host plant but even these showed much overlap. The remaining meristic characters were all very similar.

The mean number of dorsal tubercles was also similar for all the samples studied, and appeared to be independent of host plant species and of the position on the host. In North America, both Williams & Kosztarab (1972) and Gill *et al.* (1977) found up to a total of 12 dorsal tubercles, but the maximum on Polish adult females was only ten.

In 1967, Hodgson suggested that the presence or absence of the dorsal tubular ducts and the ventral tubular ducts found near the genital opening might be affected by the development site of the females on the plant, and that these ducts might be absent from specimens taken from the leaves. However, on the Polish material studied here, these ducts could be present or absent.

The specimens off *Iresine herbstii* clearly differed from the other material in lacking dorsal tubular ducts and pocket-like sclerotisations, and also in the shape and size of their dorsal setae. In addition, the mean values for all measured characters and for the two meristic characters were the smallest in comparison with those off the other four host plants. More females from this host plant should be examined to confirm these results.

Although *C. hesperidum* has been redescribed many times in the last twenty or so years (Hodgson, 1967, 1994; Ezzat & Hussein, 1969; Williams & Kosztarab, 1972; Gill *et al.*, 1977; Tereznikova, 1981; Williams & Watson, 1990), pocket-like sclerotisations have never been noted before. Even within the material studied (all from Poland), pocket-like sclerotisations was absent from all specimens off *Iresine*, suggesting that this may be a host-induced difference.

REFERENCES

BLAIR, C.A., BLACKITH, R.E., BORATYNSKI, K., 1964 - Variation in *Coccus hesperidum* L. (Homoptera, Coccidae). *Proceedings of the Royal Entomological Society of London* (A), 39: 129-134.

EZZAT, Y.M., HUSSEIN, N.A., 1969 - Redescription and classification of the family Coccidae in U.A.R. (Homoptera: Coccoidea). *Bulletin de las Société Entomologique d'Egypte* (1967), 51: 359-426.

FONSECA, J.C. DA, 1953 - Contribuiçao para o estudo do *Coccus hesperidum* L. (Hemiptera, Coccoidea). I - *Estudo Sistemático e Morfõlogico, Brotéria*, 22: 5-53, 97-114.

GILL, R.J., NAKAHARA, S., WILLIAMS, M.J., 1977 - A review of the genus *Coccus* Linnaeus in America north of Panama (Homoptera: Coccoidea: Coccidae). *Occasional Papers in Entomology, State of California Department of Food and Agriculture*, 24: 1-44.

HODGSON, C.J., 1967 - Notes on Rhodesian Coccidae (Homoptera: Coccoidea): Part I: The genera *Coccus*, *Parasaissetia*, *Saissetia* and a new genus *Mashona*. *Arnoldia (Rhodesia)*, 3(5): 1-22.

HODGSON, C.J., 1994 - The Scale Insect Family Coccidae: An Identification Manual to Genera. International Institute of Entomology, CAB International, Wallingford. 639pp.

TEREZNIKOVA, E.M. 1981 - Scale Insects. Eriococcidae, Kermesidae and Coccidae. *Fauna Ukraini. Akademiya Nauk Ukrainskoi RSR. Institut Zoologii. Kiev,* 20: 1-215.

WILLIAMS, M.L., KOSZTARAB, M., 1972 - Morphology and systematics of the Coccidae of Virginia with notes on their biology (Homoptera: Coccoidea). *Research Division Bulletin of the Virginia Polytechnic Institute and State University, Blacksburg*, 74: 1-215.

WILLIAMS, D.J., WATSON, G.W., 1990 - The Scale Insects of the Tropical South Pacific Region. Part 3. The Soft Scales (Coccidae) and other Families. CAB International Institute of Entomology, Wallingford, UK. 267pp.