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FOUR-LEGGED MITES (ACARI: TETRAPODILI) OF THE GENUS *ACERIA* FROM PLANTS OF THE FAMILY ASTERACEAE WITH THE DESCRIPTION OF A NEW SPECIES

ЧЕТЫРЕХНОГИЕ КЛЕЩИ (ACARI: TETRAPODILI) РОДА *ACERIA* С РАСТЕНИЙ СЕМЕЙСТВА СЛОЖНОЦВЕТНЫХ (ASTERACEAE) С ОПИСАНИЕМ НОВОГО ВИДА

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ABSTRACT

In total 73 mite species from the genus *Aceria* living on Asteraceae were described. The greatest majority of them cause damage to plants. The description of a new species, *Aceria sobhiani* sp.n., is given. For the "Overview" part of the article the list of species, based of their descriptions, was composed.

Further we use the most detailed descriptions taken from the literature for the morphological analysis. All the data were analyzed statistically to receive the information on morphological variability of species. Fifteen morphological features were studied. The correlative and factor analysis were carried out.

The dispersion of the particular species by factor scores depending on the phylogenetic status of their host plants did not show any clear groups. However, taking into account the representatives of two different subfamilies, Lactucoideae and Asteroideae, it can be noted that the species from plants of the first subfamily occupy positive areas of the second factor, and those from the plants of Asteroideae occupy mainly negative areas of this factor. Besides, the species from the subfamily Lactucoidea are positioned less compactly than the species of the subfamily Asteroideae.

It is possible that this situation is caused by the high degree of variability of the host plants themselves and the rapid tempo of evolution in this group of plants that is accompanied by the emergence of new forms.

РЕЗЮМЕ

Всего на сложноцветных описано 73 вида клещей из рода *Aceria*. Многие из них вызывают различные повреждения. В статье приводится описание нового вида *Aceria sobhiani* sp.n. с *Acroptilon repens* и обзор видов рода *Aceria* на сложноцветных с учетом морфологических особенностей этих видов.

Из наиболее полных описаний видов были взяты данные по 15 морфологическим признакам 35 видов и статистически обработаны для выяснения межвидовой изменчивости. Были выполнены корреляционный и факторный анализы.

Распределение видов по значениям факторов в связи с систематическим положением их растений-хозяев не показало каких-то определенных закономерностей. Однако можно отметить, что виды с растений подсемейства Lactucoideae занимают положительные области второго фактора, а виды с растений подсемейства Asteroideae — преимущественно отрицательные; кроме того, виды с растений подсемейства Lactucoidea распределены гораздо менее компактно, чем виды с растений подсемейства Asteroideae.

Возможно, обилие морфологически близких видов рода *Aceria* на сложноцветных и высокая степень внутривидовой изменчивости признаков связана с высокой степенью изменчивости самих растений-хозяев и быстрыми темпами их эволюции, сопровождающимися появлением новых групп.

The Asteraceae is the most abundant and widespread family of plants and includes more than 20 thousand species. Most four-legged mites living on Asteracea plants belong to the genus *Aceria*. Many of these species are importants pests. Thus, the

research on this mite group has applied importance, for example, the observations on *Aceria acroptiloni*, the native enemy of the weed *Acroptilon repens* (L.) DC [Kovalev, Shevchenko, Danilov, 1974] or the study of *A.chondrillae*, used in biological control of weeds of the genus *Chondrilla* [Caresch, Wasphere, 1974; Coolen, Moore, 1983] and many other genera of Asteraceae.

Seventy-three species of mites of the genus *Aceria* living on Asteraceae were described. Most of them cause various damage to plant hosts (gall formation, flower deformation, stunting of growth etc.) Many species of this genus were described by Nalepa, and most of the species were never redescribed. For example, the description of the species *A.chondrillae* is insufficient [Canestrini, 1892], and the recent description of its females is fragmentary [Krantz, Ehresing, 1990]. It makes impossible to undertake a revision of this group and develop a key to its species. The lack of knowledge of the group of mites in a whole affects studies on particular species, pests of certain Asteraceae.

The paper is focused not only on the description of a new species of this genus, but also on the preliminary review of the species of Aceria on Asteraceae. This will help to analyze the morphological diversity of these mites and their morphological variability.

MATERIAL AND METODS

This paper is divided into two parts. For the overview part of the article the list of species, based of their descriptions, was compiled. We used the most detailed descriptions taken from the literature in the morphological analysis. All the data (14 features) were analized statistically to receive the information on morphological variability of species. The correlative and factor analysis were carried out to reveal the connections of the features and compare the species by the complex of features. The details of statistical analysis and the interpretation of its results are given in the corresponding chapter. The second part of the article deals with the description of a new species.

THE LIST OF SPECIES OF THE GENUS *ACERIA* ON ASTERACEAE

The family Asteraceae (=Compositae) was divided into two subfamilies: the large and diverse subfamily Asteroideae and the small and homogenous subfamily Lactucoideae (=Cichorioideae) [Takhtajan, 1987]. We organized the list of species in accordance with this division. Many described species are very close to others by their morphological features. It is possible that some of them are in fact synonyms.

I. Mites from plants of the subfamily Lactucoidea

1. *Aceria acroptiloni* Kovalev et Shevchenko, 1974. Host plant: *Acroptilon repens* (L) DC (Cardueae). Relation to the host plant: mites cause flower galls. Distribution: Central Asia, Kazakhstan and Crimea.

2. *A.affinis* (Nalepa, 1904). Host plant: *Artemisia arborescens* L. (Anthemideae). Relation to the host plant: mites cause leaf galls. Distriburion: Europe.

3. *A.antocoptes* (Nalepa, 1904). Host plant: *Cirsium arvense, C.heterophyllum* (Cardueae). Relation to the host plant: mites cause flower galls. Distribution: Europe.

4. *A.balasi* Farkas, 1960. Host plant: *Carduus acantoides* L. (Cardueae). Relation to the host plant: mites cause leaf galls. Distribution: Europe.

5. *A.brevicincta* (Nalepa, 1899). Host plant: *Jurinea mollis* Reichb. (Cardueae). Relation to the host plant: mites cause flower galls. Distribution: Europe.

6. *A.centaureae* (Nalepa, 189). Host plant: *Centaurea maculosa* L., *C.diffusa* Lam.(Cardueae). Relation to the host plant: mites cause blister galls on leaves and young stems. Distribution: Europe.

7. *A.chondrillae* (Canestrini, 1892). Host plant: *Chondrilla juncea* L., *C.brevirostris, C.leiosperma* (Lactuceae). Relation to the host plant: mites induce the vegetative and flower buds to form leafy galls, causing stunting of the plant and reducing seedling. Distribution: Europe.

8. *A.chrysactiniae* Keifer, 1962. Host plant: *Chrysactinia mexicana* (Liabeae). Relation to the host plant: mites occur around buds. Distribution: Texas, USA.

9. *A.echinopsi* Boczek et Nuzzacci, 1988. Host plant: *Echinops* sp. (Echinopeae). Relation to the host plant: subspherical galls, with cells inside, along margin of leaves. Distribution: Libya, Africa.

10. *A.grandis* (Nalepa, 1904). Host plant: *Centaurea rhenana* Boreau (Cardueae). Relation to the host plant: mites cause flower deformation. Distribution: Europe.

11. *A.inturbida* Boczek, 1961. Host plant: *Arctium lappa* L. (Cardueae). Relation to the host plant: mites are undersurface vagrants among the leaf hairs. Distribution: Europe, Poland.

12. *A.lactuceae* (Canestrini, 1894). Host plant: *Lactuca saligna* L. (Lactuceae). Relation to the

host plant: mites induce flower and leaf deformation. Distribution: Europe.

13. *A.lappae* (Liro, 1943). Host plant: *Arctium tomentosum* Mill. (Cardueae). Localization: free-living on the undersurface of leaves. Distribution: Europe: Finland, Hungary.

14. *A.longiseta* (Nalepa, 1891). Host plant: *Hieracium murorum* L. (Lactuceae). Relation to the host plant: mites cause leaf edge roll. Distribution: Western Europe.

15. *A.picridis* (Canestrini et Massalongo, 1894). Host-plant: *Picris hieracioides* L. (Lactuceae). Relation to the host plant: mites form leaf galls. Distribution: Europe.

16. *A.pilosellae* (Nalepa, 1895). Host plant: *Hieracium pilosella* L. (Lactuceae). Relation to the host plant: mites cause leaf edge roll. Distribution: Europe.

17. *A.reichingeri* (Nalepa, 1904). Host plant: *Crepis biennis* L. (Lactuceae). Relation to the host plant: mites cause flower galls. Distribution: Europe.

18. *A.saussureae* (Liro, 1940). Host plant: *Saussurea alpina* (L.) DC (Cardueae). Relation to the host plant: mites cause blister galls and erineum. Distribution: Europe, Finland.

19. *A.sonchi* (Nal.1904). Host plant: *Sonchus maritimus* L. (Lactuceae). Relation to the host plant: mites form leaf galls. Distribution: Europe.

20. *A.thessalonicae* Castagnoli, 1987. Host plant: *Centaurea diffusa* Lam. Relation to the host plant: mites are vagrant on the aerial part of rosettes and bolting plants; they cause abnormalities in grows, with broom-like appearance. Distribution: Europe: Italy, Greece.

II. Mites from plants of the subfamily Asteroidea

1. *A.abalis* Keifer, 1940. Host plant: *Artemisia heterophylla* Nutt. (Anthemideae). Relation to the host plant: mites form hairy pockets on the under sides of leaves. Distribution: California, USA.

2. *A.absynthii* Liro, 1943. Host plant: *Artemisia absinthium* L. (Anthemideae). Relation to the host plant: free-living mites are found on leaves. Distribution: Europe, Finland.

3. *A.achilleae* Corti, 1903. Host plant: *Achillea moschata* Wulfen (Anthemideae). Relation to the host plant: mites cause flower deformation and hairiness. Distribution: Europe.

4. *A.adoratus* Keifer, 1970. Host plant: *Eupatorium adoratum* L. (Eupatorieae). Relation to the host plant: mites make small erineum tufte on the undersides of leaves. Distribution: Trinidad, West Indies.

5. *A.affinis* Nal.,1904. Host plant: *Artemisia arborescens* L. (Anthemideae). Relation to the host plant: mites form leaf galls. Distribution: Europe.

6. *A.alfierii* Sayed, 1946. Host plant: *Pluchea dioscoridia* (Inuleae). Relation to the host-plant: mites form leaf galls. Distribution: Egypte.

7. *A.ambrosiae* Wilson, 1959. Host plant: *Ambrosia psilostachia* DC (Ambrosieae). Relation to the host plant: mites found in buds, in leaf axils and on young leaves; a stunting and twisting of young leaves can present, when the population is high. Distribution: California, USA.

8. *A.ambrosioidea* Keifer, 1966. Host plant: *Franseria ambrosioides* (Ambrosieae). Relation to the host plant: mites form irregular leaf galls. Distribution: California, USA.

9. *A.artemisiae* (Canestrini, 1892). Host plant: *Artemisia vulgaris* L. (Anthemideae). Relation to the host plant: mites form galls. Distribution: Europe.

10. *A.artemisiae-campestris* Liro, 1943. Host plant: *Artemisia campestris* L. (Anthemideae). Relation to the host plant: mites live on the undersides of leaves. Distribution: Europe.

11. *A.astibonis* Keifer, 1960. Host plant: *Franseria dumosa* (Ambrosieae). Relation to the host plant: mites live among hairs on leaves. Distribution: California, USA.

12. *A.baccharipha* Keifer, 1970. Host plant: *Baccharis pilularis* consanguinea (DC.) (Astereae). Relation to the host plant: mites cause blisters in the leaves. Distribution: California, USA.

13. *A.beevori* Keifer, 1951. Host plant: *Wyethia* sp. (Calenduleae). Relation to the host plant: mites form galls in flower heads, sometimes completely aborting the flower. Distribution: California, USA.

14. *A.boycei* Keifer, 1943. Host plant: *Ambrosia psilostachya* DC. Relation to the host plant: mites form the leaf galls. Distribution: California, USA.

15. *A.caborcensis* Keifer, 1965. Host plant: *Franseria* sp. (Ambrosieae). Relation to the host plant: mites form irregular leaf galls. Distribution: Mexico.

16. *A.calcarifer* (Liro, 1943). Host plant: *Tussilago farfara* L. (Senecioneae). Relation to the host plant: mites were found among the leaf hairs. Distribution: Finland.

17. *A.calibaccharis* Keifer, 1966. Host plant: *Baccharis pilularis* D.C. (Astereae). Relation to the host plant: mites are found in the leaf axils around the buds. Distribution: California, USA.

18. *A.caliplucheae* Keifer, 1939. Host plant: *Pluchea sericea* Nutt. (Inuleae). Relation to the

host plant: mites are found around the terminal bud and among leaf hairs. Distribution: California, USA.

19. *A.chrysopsis* Keifer, 1940. Host plant: *Chrysopsis oregona* Gray (Astereae). Relation to the host plant: mites are found in the leaf axils along the stems. Distribution: California,USA.

20. *A.chrysothamni* Wilson, 1959. Host plant: *Chrysothamnus* sp. (Astereae). Relation to the host plant: mites were found among the hairs on both leaf surface and in the leaf axils; no apparent damage was observed. Distribution: California, USA.

21. *A.dicoriae* Keifer, 1962. Host plant: *Dicoria canescens* T. & G. (Ambrosieae). Relation to the host plant: mites are in the terminals and flowers. Distribution: California, USA.

22. *A.douglasiana* Wilson & Oldfield, 1966. Host plant: *Artemisia douglasiana* Besser (Anthemideae). Relation to the host plant: mites live among the hairs on both leaf surfaces. Distribution: California, USA.

23. *A.dracunculi* (Keifer, 1939). Host plant: *Artemisia dracunculus* L. (Anthemideae). Relation to the host plant: mites produce a severely stunted and thickened condition of the shoots, forming a ball-like structure, set thickly with aborted leaves and flowers. Distribution: California, USA.

24. *A.enceliae* Keifer, 1939. Host plant: *Encelia californica* Nutt. (Heliantheae). Relation to the host plant: mites are found in the surface hair and around the buds. Distribution: California, USA.

25. *A.eupatorii* Roivainen, 1953. Host plant: *Eupatorium cannabinum* L. (Eupatorieae). Relation to the host plant: mites make leaf edge roll. Distribution: Europe: Spain.

26. *A.franseriae* Wilson & Oldfield, 1966. Host plant: *Franseria chenopodiifolia* Bentham. (Ambrosieae). Relation to the host plant: mites form leaf galls. Distribution: Mexico.

27. *A.izhevskii* Liv., Mitr. et Shar., 1983. Host plant: *Ambrosia* sp. (Ambrosieae). Relation to the host plant: the information is absent. Distribution: Caucasus, Georgia.

28. *A.haplopappi* (Keifer, 1939). Host plant: *Haplopappus venetus* H.B.K. (Astereae). Relation to the host plant: \ mites are found near the base of current growth in the axils of leaves. Distribution: California, USA.

29. *A.heterothecae* (Keifer, 1939). Host plant: *Heterotheca grandiflora* Nutt. (Astereae). Relation to the host plant: mites are found at the bases and in the hair of leaves. Distribution: California, USA.

30. *A.keifferi* (Corti) Liro, 1940;Nalepa, 1890. Host plant: *Achillea millefolium* L. (Anthemideae). Relation to the host plant: mites cause flower deformation. Distribution: Europe.

31. *A.knorri* Keifer, 1962. Host plant: *Bidens pilosa* L. (Heliantheae). Relation to the host plant: mites form flower galls. Distribution: Florida, USA.

32. *A.langei* Keifer, 1939. Host plant: *Eriophyllum stacchadifolium* Lag. (Astereae). Relation to the host plant: free-living on the undersurface of leaves and in leaf axils. Distribution: California, USA.

33. *A.linosyrina* (Nalepa, 1897). Host plant: *Aster linosyris* Bernh. (Astereae). Relation to the host plant: mites induce deformations of the axils and abnormalities in growth with broom-like appearance. Distribution: Europe.

34. *A.maracai* Boczeck & Nuzzacci, 1988. Host plant: *Pluchea odorata* (L) Cass. (Inuleae). Relation to the host plant: the mites make galls on the lower leaf surface. Distribution: South America, Venezuela.

35. *A.marginemvolvens* (Corti, 1911). Host plant: *Artemisia vulgaris* L. (Anthemideae). Relation to the host plant: mites form galls rolling the leaf margin. Distribution: Europe.

36. *A.neoartemisiae* (Keifer, 1938). Host plant: *Artemisia heterophylla* Nutt. (Anthemideae). Relation to the host plant: the mites are found on the undersides of the leaves or in the buds. Distribution: California, USA.

37. *A.odorata* Cromroy, 1958. Host plant: Pluchea odorata (L) Cass. (Inuleae). Relation to host plant: mites make galls and erineum on the leaves. Distribution: Central America, Puerto Rico.

38. *A.opistolia* (Nalepa, 1895). Host plant: *Aster bellidiastrum* Scop. (Astereae). Relation to the host plant: mites make leaf edge roll. Distribution: Europe.

39. *A.osmiae* Cromroy, 1958. Host plant: *Osmia odorata*. Relation to the host plant: mites make erineum on the leaves. Distribution: Central America, Puerto Rico.

40. *A.oreadis* Keifer, 1966. Host plant: *Artemisia tridentata* Nutt. (Anthemideae). Relation to the host plant: mites frequent the buds and leaf bases. Distribution: California, USA.

41. *A.palafoxiae* Keifer, 1965. Host plant: *Palafoxia linearis* (Cav.) (Heliantheae). Relation to the host plant: mites live among buds and leaf hairs. Distribution: Arisona, USA.

42. *A.paracalifornica* (Keifer, 1939). Host plant: *Artemisia californica* Less. (Anthemideae). Relation to the host plant: mites live among the hairs and form hairy thickenings on the leaflets. Distribution: California, USA.

43. *A.portalis* Keifer, 1965. Host plant: *Artemisia tridentata* Nutt. (Anthemideae). Relation to the host plant: mites live among buds and leaf hairs. Distribution: California, USA.

44. *A.potosensis* (Keifer, 1976). Host plant: *Ambrosia* sp. (Ambrosieae). Relation to the host plant: it is not possible to state what the mite does on its host. Distribution: Mexico.

45. *A.puculosa* (Nalepa, 1895). Host plant: *Erigeron acer* L. (Astereae). Relation to the host plant: mites form flower deformations. Distribution: Europe.

46. *A.purpurascenis* Cromroy, 1958. Host plant: *Pluchea purpurascenis* (Inuleae). Relation to the host plant: mites make galls on the leaves. Distribution: Cayey, Puerto Rico.

47. *A.pynocephalae* Keifer, 1955. Host plant: *Artemisia pynocephala* DC (Anthemideae). Relation to the host plant: mites live in buds; especially the flower buds, which grow in tolerably long spikes. Distribution: California, USA.

48. *A.trifila* Keifer, 1965. Host plant: *Artemisia californica* Less. (Anthemideae). Relation to the host plant: mites are found around the growing tips. Distribution: California, USA.

49. *A.trinervis* (Keifer, 1976). Host plant: *Baccharis trinervis* (Lam.) (Astereae). Relation to the host plant: mites make numerous upper surface bead galls on the leaves. Distribution: South America, Venezuela.

50. *A.tuberculatus* (Nalepa, 1891). Host plant: *Chrysanthemum vulgare* L. (Astereae), *Tanacetum vulgare* L. (Anthemideae). Relation to the host plant: mites live among the leaf hairs. Distribution: Europe.

51. *A.tussilagifoliae* Boczek, 1964. Host plant: *Tussilago farfara* L. (Senecioneae). Relation to the host plant: mites are vagrants on the leafs. Distribution: Europe.

52. *A.tuttlei* Keifer, 1960. Host plant: *Aster* sp. (Astereae). Relation to the host plant: mites live among the leaf hairs. Distribution: Arizona, USA.

53. *A.wyethiae* Keifer, 1951. Host plant: *Wyethia* sp. (Calenduleae). Relation to the host plant: mites are under-surface vagrants among the leaf hairs. Distribution: California, USA.

THE PRESENT STATE OF KNOWLEDGE OF THE SPECIES OF *ACERIA* ASSOCIATED WITH ASTERACEAE

At present this list includes 53 species from Asteroideae and 20 species from Lactucoideae. The first descriptions of the species by Corti, Nalepa and Canestrini are known from the end of the XIX century. They were the European species. Later descriptions dealt mostly with the North American species, mainly from California, and were made by Keifer.

Several species of those mites, including those described by Nalepa were not mentioned in the literature after the original description. For exemple, such species as *Aceria sonchi* (Nal.), *A.picridis* (Can. et Mass.). Most of Nalepa's species were mentioned only once in the work of Farkash [1963] on the European four-legged mites. However, the comparison of diagnoses of species provided by Nalepa and later by Farkas demonstrates numerous discrepancies between them. For example, there are some differences in the charasteristics of the shield provided in the original description and by Farkas in such species as *A.chondrillae* (Can.), *A.centaureae* (Can.), *A.artemisieae* (Can.) and *A.sonchi* (Nal.). In later works no special attention was given to the morphology of species of the genus. For example, Krantz and Ehrensing [1990] described the deutoginous form of *A.chodrillae*, but demonstrated only the mite's profile, making it impossible to see the shield and epigynium. Almost every new mite found on Asteraceae is described as a new species. The comparison of the species *A.dracunculi* and *A.neoartemisiae* from *Artemisia*, *A.dicoriae* and *A.astibonis* from *Ambrosia* shows that these species are very similar and hardly discernible. Two species from Africa, *A.maracai* and *A.echinopsi* [Boszeck, Nuzzacci, 1988], should be taken off the list, because *A.maracai* lack the tibial chaeta on its foreleg (the genus *Acalitus* feature) and *A.echinopsi* have a suboral plate in the contrast to other *Aceria* species.

Aceria sobhiani sp. n.

Fig. 1.

Female: 175–220* long, 50 thick, worm-like. Rostrum 26 (25–27.5), curved down and directed forward. Shield 26 (25–27.2) long, 36 (35–37) wide; shield pattern: median and admedian lines complete, submedian line I is diverging at the level of dorsal tubercles and form two branches: the internal one is more distinct and continues the principal part of the submedian line I, the external branch originates from the submedian line. The submedian line II is less distinct and placed in the anterior part of the shield. Shield sides are completely covered with the short dashes. Dorsal tubercles 22 (21.2–22.5) apart, dorsal setae 39 (38–49) long, projecting backwards.

*All measurements are given in micrometers (μm).

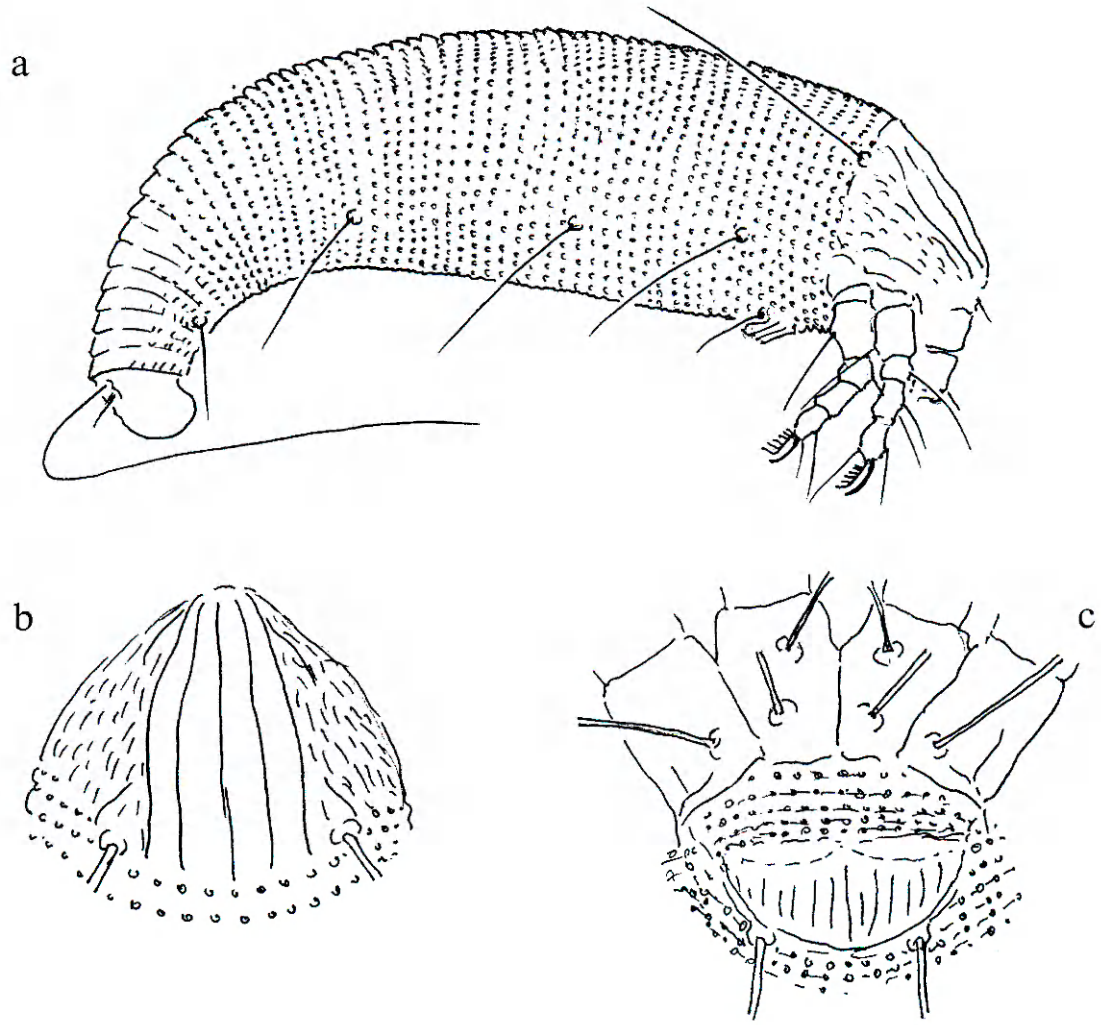

Fig. 1. *Aceria sobhiani* sp.n. a — female, b — dorsal shield, c — epigynium and coxae.
Рис. 1. *Aceria sobhiani* sp.n. a — самка, b — дорсальный щиток, c — эпигиний и коксо-стернальный скелет.

Foreleg 29 (28–30) long, tibia 6 (5–6.3) with seta 10 long, tarsus 7 (6.3–7.5), claw 8 (7.5–8.7) feather claw is a little shorter, 5-rayed. Patella bears seta, 30. Hindleg 26 (23–26.2), tibia 6 (5–6.3), tarsus 6.5 (6.3–7), claw 9.5 (8.7–10.5) a little longer as a claw on the foreleg, feather claw 5-rayed. Coxae smooth (plain).

Abdomen with 55 (53–57) dorsal rings, and 60 (59–60) ventral rings before epigynium and 5–7 behind them. Microtubercles equally developed dorsally and ventrally.

Lateral seta 32 long, on ring 7–9 behind lateral shield margin, first ventral seta 45 (42–48) long, its tubercles 13–14 rings apart, second ventral seta 42 (40–44) long, on 17–19 ring from the first, third ventral seta 27 (25–29) long, on 20–22 ring from the second. Telosoma has 5 rings. Accessory seta 4.8 (4.2–5) long, caudal seta about 60 long, its end is very thin. Female genitalia 11 (10–11.3) long, 23 (22.5–23.7) wide, coverflap with about 14 longuitudinal furrows, genital seta 19 long.

Male: length 150, width 45, with 49 rings.

Host-plant: *Acroptilon repens* (L.) DC (Asteraceae, Lactuceae) Relation to the host: mites induce shoot proliferatrion, development of abnormal hairiness of leaves and shoots, and cause stunting of the plant.

Type material: Holotype: female (slide-mounted). Paratypes: 5 females and 1 male. Uzbekistan, vicinities of Kokand. Collected May, 1996. Coll. R.Sobhian.

REMARKS

This species can be included in the species group *Aceria*, described from different species of plants of the genus *Centaurea*: *Aceria centaurea* (Nal.), *A.grandis* (Nal.), *A.calathidis* (Gerber) and *A.thessalonicae* Castagnoli [Castagnoli, Sobhian.

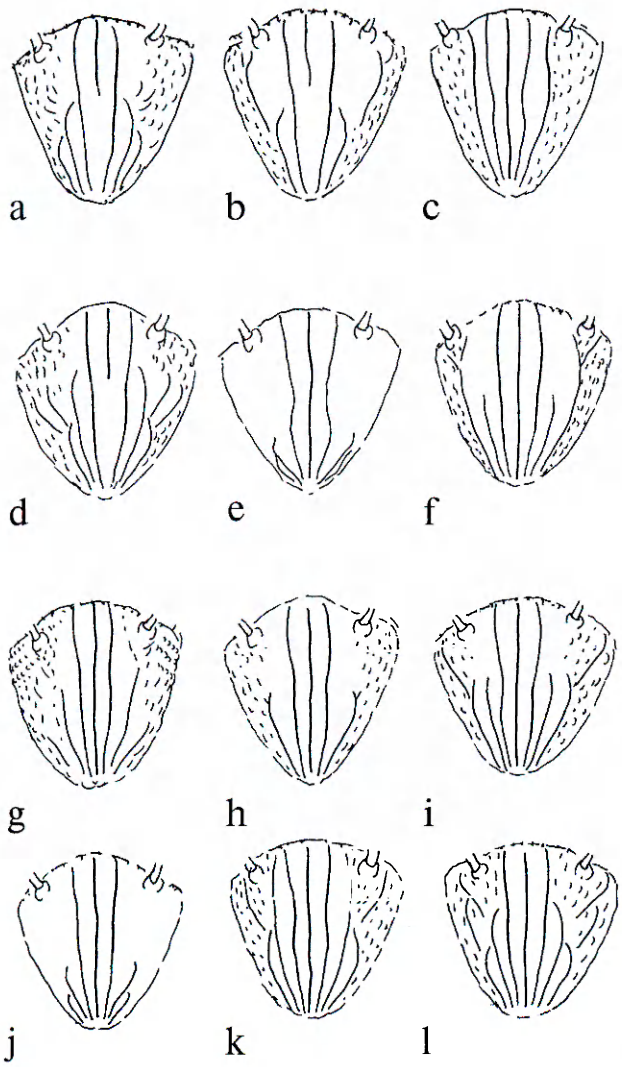

Fig. 2. The shields of any species of the genus *Aceria* from Asteraceae plants: a,b — *A.chondrillae* [a — by: Casnestrini, 1882, b — by: Farkas, 1963]; c — *A.thessalonicae* [by: Castagnoli, Sobhian, 1991]; d,e,f — *A.centaureae* [d — by: Nalepa, 1891, e — by: Farkas, 1963, f — by: Castagnoli, Sobhian, 1991]; g,h — *A.artemisiae* [g — by: Nalepa, 1910, h — by: Farkas, 1963], i — *A.neoartemisiae* [by: Keifer, 1938]; j — *A.inturbida* [by: Boczek, 1961], k — *A.haplopappi* [by: Keifer,1939], l — *A.dracunculi* [by: Keifer, 1939].

Рис. 2. Щитки некоторых видов клещей рода *Aceria* со сложноцветных. a,b — *A.chondrillae* [a — по: Casnestrini, 1882, b — по: Farkas, 1963] ; c — *A.thessalonicae* [по: Castagnoli, Sobhian, 1991]; d,e,f — *A.centaureae* [d — по: Nalepa, 1891, e — по: Farkas, 1963, f — по: Castagnoli, Sobhian, 1991]; g,h — *A.artemisiae* [g — по: Nalepa, 1910, h — по: Farkas, 1963], i — *A.neoartemisiae* [по: Keifer, 1938]; j — *A.inturbida* [по: Boczek, 1961], k — *A.haplopappi* [по: Keifer,1939], l — *A.dracunculi* [по: Keifer, 1939].

1991]. It is almost identical with the species *A.thessalonicae*, but the principal distinguishing feature is the presence of bifurcated submedian line I anteriad to dorsal tubercles. This feature is not characteristic of every specimen, because it may vary intraspecifically. However, the systematic difference of its host plant as well as the difference of the character of the caused disease make it possible to conclude that this species is a new one.

ANALYSIS OF THE VARIABILITY OF CHARACTERS

The listed morphological features of 37 OTUS of 35 species were used for statistical analysis: 26 species of them were from Astereae plants, 8 species from Cardueae, including three forms of females of *A.acroptiloni*. We studied the variability of 15 morphological features of these species.

Fifteen character states were examined: 1) length of the body (L), 2) length of the dorsal shield (Sh), 3) length of the gnathosoma (Gn), 4) length of the dorsal seta (s.d.), 5) number of dorsal abdominal rings (DRg), 6) length of forelegs (Lg), 7) length of tibia (Ti), 8) length of tarsus (Ta), 9) length of the feather claw (Cl), 10) number of empodial rays (Ray), 11) length of the female genital coverflap (Eln), 12) width of the female genital coverflap (Ewd), 13) length of submedian line 1 (Sub), 14) presence of two branches on rear end of submedian line 1 (Br), 15) length of median line (Med). All features are given in micrometers, except the 13) and 15), which are given in fractional numbers (corresponding to the parts of the shield, occupied by these lines).

This group is homogenous by its quantitative features. The minimum coefficient of variability (CV%) is of the gnathosoma length (16.8), foreleg length (16.7) and shield length (17.2). The greatest value corresponds to s.d. length (39.5). The separate parts of the leg tibia and tarsus are more changeable than a leg in a whole; the length of tibia is more changeable as that of tarsus. The intermediate position is occupied by a number of dorsal rings (20.3). Regrettably, the intraspecific variability was not studied, so it is difficult to estimate the value of mentioned features for systematic studies.

It is important to take into consideration the shield pattern to characterize this group of species. The principal differences in its design between species are the length of median line and the length and form of submedian lines. Regrettably, not much attention was paid to this feature in the literature. As it was stated above, the shield pattern of *A.chondrillae* described by Farkas [1963] differs from that in the original description [Canestrini, 1882] (Fig. 2a,b). Krantz and Ehrensing [1990] in their description of deutogynous and protogynous females did not show the shield design. In the redescription of *A.centaureae* [Castagnoli, Sobhi-

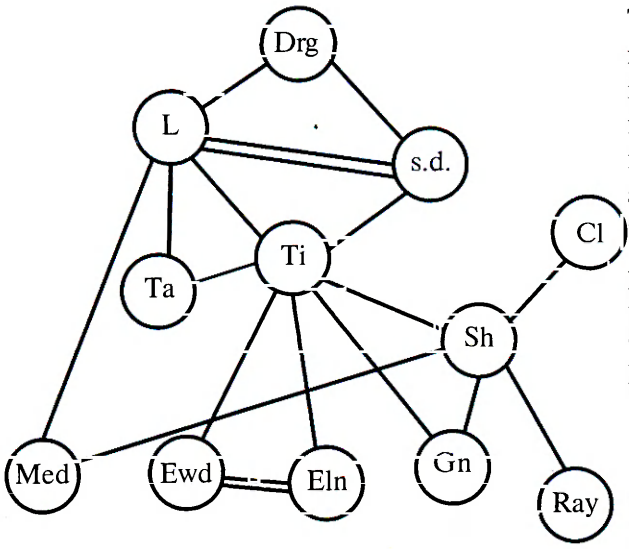

Fig. 3. Correlative relations of the features of 39 OTU's of the genus *Aceria* from Compositae. Single line demonstrates r=0.45-0.69, double line — r=0.7. The numeration of the features is given in the text. The negative correlations are absent.
Рис. 3. Корреляционная структура признаков 39 ОТЕ рода *Aceria* со сложноцветных. Одинарная линия соответствует коэффициенту корреляции от 0.45 до 0.69, двойная — коэффициенту корреляции выше 0.7. Отрицательные корреляции отсутствуют.

an, 1991] the shield pattern is not in accordance with the original description [Nalepa, 1891] (Fig. 2d,e,f). It is not clear, if this situation is caused by the intraspecific variability.

Meanwhile, we can separate the group of species having the similar shield designs. It has complete median and admedian lines, and the sudmedian line I, almost complete and bifurcated before dorsal tubercles. This shield characterizes mites from Lactudoideae plants: *A.centaurea*, *A.grandis*, *A.anthocoptes*, *A.inturbida*, *A.thessalonicae* (Fig. 2c,i), *A.eupatorii*, *A.langei*. Other characteristics of these species (s.d. length, number of dorsal rings etc.) are very different.

Another species group can be also found on Asteroideae. Those are the species, having short submedian line I, which is situated in the frontal part of the shield, with the rear end turned to admedian line. These species are as follows: *A.neoartemisiae* (Fig. 2j), *A.chondrillae* [by Canestrini, 1882], *A.balasi, A.haplopappi, A.tuttlei* (Fig. 2k,l). This group is less distinct than the previous one.

CORRELATIVE ANALYSIS

The correlative structure of features (Fig.3) shows that the closest connection exists between the length and widtn of epigynium and, which is less evident, between the body and the s.d. lengths. Two of these features have correlations with the number of dorsal rings and foreleg lengths (including the lengths of tibiae and tarsi). Concerning the forelegs, only the length of tarsus is present on the figure. The lengths of the foreleg and its tibia are absent, because they have the high correlations with each other and the majority of other features. As to the shield pattern, only the median line's length has the high positive correlation with the shield length. The other two features of the shield pattern are absent on the figure.

FACTOR ANALYSIS

Factor analysis was used to examine the integrated features variability (as one of the multivariate methods). We have observed the factor weights of the features and the distribution of the factor scores of the examined species in the first two factors areas. The first factor has 38% of variance, the second 13%.

The factorial structure of fifteen considered features and factor scores of 37 OTUS were obtained. Factorial structure has shown a high degree of correlation with the first factor of suppressing majority of dimensioned features, particularly length of body, legs and its parts, dorsal setae length and dorsal rings number have high positive correlations with them. Such features as the length of the dorsal shield and gnathosoma, and the presence of two branches of submedian line have a high positive correlation with the second factor.

The dispersion of species by factor scores (Fig.4) did not show any clear groups. The most condensation of points is observed mainly in the field where the axes of both factors cross with each other and which contains the main mass of points. The dispersion of species in a connection with the systematic position of their host plants did not show clear regularities.

However, considering inhabitants of two different subfamilies Lactucoideae and Asteroideae, it can be noted that the species from plants of the first subfamily occupy positive areas of the second factor, and those from the plants of Asteroideae occupy mainly negative areas of this factor. Besides, the species from the subfamily Lactucoidea are distributed less compact than the species from the subfamily Asteroideae.

Regularities, connected with the incorporation of the host plants into different tribes (Fig.4) were tracked weakly. The groups of species from the tribes Anthemideae, Heliantheae and Ambrosieae almost coincide; the most extreme positions in the

negative area of the second factor are occuped by the species from the plants of the tribe Astereae. Moreover, the species from Ambrosieae and Anthemideae are distributed more condensely, and the species from Astereae have the greater dispersion.

The inhabitants of plants of the same genus are not isolated. Seven species of mites from plants of the genera *Ambrosia* and *Franseria,* which are often synonymized as *Ambrosia* [Payne, 1963], can serve as an example. These species are very similar by the measured features. However, they are well discernible by the shield design. Eight species of mites from plants of the genus *Artemisia* are even more close to each other.

It is impossible to compare the mapping of the species according to selected features with their geographical distribution, as the species from plants of the subfamily Lactucoideae are found in Europe and Asia, but the species from plants of the subfamily Asteroideae are known mostly from Americas.

The OTUS, belonging to *A.acroptiloni* that is presented by three forms of females (numbers 6, 7 and 8 on the Fig.4), are more remote from each other than the OTUS, belonging to different species, that shows the high degree of intraspecific variability.

DISCUSSION

Many different research approaches and methods should be used to study economically important species. Most of these mites are narrow oligophagous or even monophagous (especially, gall-inducing mites). Related species and genera of plants are closely associated with groups of similar forms (species and subspecies) of four-legged mites. These species of mites have often a strong morphological resemblance by qualitative and quantitative features. At the same time the correct identification of mites is a necessary condition for their further studies, particularly, when the subject includes economically important species.

Thus, it is insufficient to the updated descriptions of economically significant species, but it is necessary to define their place in the group of similar species. It is also important to visualize distinctly a degree of variability of features of these species. This was demonstrated by us using mites from cereals as an example [Sukhareva, 1992, ch.III]. Positive results could be obtained from studying the intraspecific variability of features, serving for explanation of seasonal dimorphism of specimens, hostal and geographical races.

Monographical study of mites inhabiting any phylum of plants helps to reveal particular stages of coevolution of mites and their host plants, to distinguish the groups of related species, connected with tribes of plants, as it was shown for mites inhabiting cereals [Sukhareva, 1992]. Concerning the mites of the genus *Aceria* on Asteraceae plants, it is impossible to separate any distinct groups of species, connected with phylogenetic groups of hosts.

Even the establishing of species groups by similarities in shield designs, does not allow to consider certain individual as an inhabitant of plants of the subfamilies Asteroideae or Lactucoideae. Also the content of these two subfamilies is not equivalent in different systems of Asteraceae [Takhtajan, 1987]. Application of morphological data is not easy because of the presence of intraspecific variability, associated with the seasonal dimorphism. The last phenomenon was studied in detail only for the species *A.acroptiloni* [Kovalev, Shevchenko, Danilov, 1974].

It is possible that this situation is caused by the high degree of variability of host plants themselves and the rapid tempo of evolution in this group of plants, accompanying by the development of new forms. One of the special features of the evolution of Asteraceae is its biochemical direction, associated with the synthesis of the sesquiterpens, the analogs of juvenile hormones of insects [Kovalev, 1995]. It results in developing the physiologically specific new forms of plants. This large spectrum of biochemical diversity can affect the evolution of gall-provocative mites and insects, especially in the case of monophagous and oligophagous invertebrates.

Among the species of the genus *Aceria* there are very similar, almost identical species of mites (for example, *A.tessalonicae* and *A.sobhiani*), inhabiting the phylogenetically remote hosts, which are sometimes different ecologically. Studying the morphologically similar species of mites, we should take into consideration their biochemical features. However, since this area of research is only about to be developed, we can simplify the problem, considering the taxonomy of the host plants and the character of damages caused by mites.

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