Türk. entomol. derg., 1993, **17** (3) : 129-140
ISSN 1010-6960

Studies on taxonomy, distribution and host plants of Turkish species of *Circulifer* Zakhvatkin (Homoptera: Cicadellidae)

Hüseyin BAŞPINAR* Ulrich KERSTING** Çetin ŞENGONCA** Nedim UYGUN*

Summary

During this five-year study three distinct species complexes of the genus ***Circulifer*** were found in Turkey.

Circulifer haematoceps (Mulsant and Rey) complex had a triangulate male genitalia plate and slightly bent apices of styles. This complex was widely distributed and common on 27 host plants. ***Circulifer opacipennis*** (Lethierry) complex revealed a strong lateral curved apical extension of the style and the male genitalia plate was triangulate. The only host plant of this complex was ***Salsola kali*** L. The distribution patterns of ***C. opacipennis*** complex were similar to their host ***S. kali***. No evidence was found that more than one species was involved in each of both complexes. ***Circulifer tenellus*** (Baker) complex had quadrilateral plates, but the plates were quiet variable. The apex of the styles was only slightly bent. ***C. tenellus*** complex was only found on sugar beets in Ereğli (Konya plain). Because of the great variation of the plate several species or even hybrids might be involved in this complex.

The results of this study showed clearly that the genus ***Circulifer*** has urgent need of detailed work and revision.

Introduction

The leafhopper species of the genus ***Circulifer*** Zakhvatkin (Homoptera: Cicadellidae) are probably the most important species of Cicadellidae in Turkey and the Mediterranean region. ***Circulifer tenellus*** (Baker) complex and ***Circulifer haematoceps*** (Mulsant and Rey) complex serve as a vector of at least two destructive plant diseases. Firstly, both are vectors of the sugar beet curly-top virus. (BCTV) in

* University of Çukurova, Department of Plant Protection, 01330 Adana, Turkey
** Institute of Phytopathology, University of Bonn, 5300 Bonn, Germany
Alınış (Received): 10.9.1992

Turkey and Iran (Bennett and Tanrısever, 1957; Kheyri, 1969). Secondly, these leafhoppers transmit the citrus stubborn disease pathogen (CSD), ***Spiroplasma citri*** Saglio et al. (Mycoplasmatales: Spiroplasmataceae), to citrus (Fos et al., 1986) and other hosts, e.g. ***Sesamum indicum*** L. (Kersting and Şengonca,1992; Kersting et al., 1992). Stubborn disease is of great significance for the Eastern Mediterranean citrus industry, causing heavy losses in yield and fruit quality each year.

According to Frazier (1953), the ***C. haematoceps*** complex is the most abundant of all encountered groups and evenly distributed in the Mediterranean region. Lodos and Kalkandelen (1985) found ***C. opacipennis*** (Lethierry) (=***C. haematoceps*** complex) very common and sometimes in large numbers in Turkey.

Recently, Klein and Raccah (1991) studied on ***Circulifer*** species of the ***haematoceps*** complex, which strongly differ in distribution and host plant range in Israel, suggesting that obviously several leafhopper species might be involved in the ***C. haematoceps*** complex. The occurrence of different types or species of this leafhopper complex in Turkey is so far unknown. For the reason that the climatic and ecological factors of Israel and Turkey are similar, at least for some regions of the South and South East part of Turkey, different populations might also occur in Turkey.

Because of the economic importance of the genus ***Circulifer***, the objective of this study was to obtain basic information with regard to the species of the ***Circulifer*** complex, their distribution, host plants, and notes on their biology in Turkey.

Material and Methods

Leafhopper collections were conducted from December 1987 to August 1992 at different locations, mainly in the South and South East parts of Turkey. This area consists of the provinces: Adana, Adıyaman, Antalya, Diyarbakır, Gaziantep, Hatay, İçel, Kahramanmaraş, Konya, Mardin, Siirt and Şanlıurfa. Additionally, some collections were also done in Erzurum (North East) in August 1991.

The collections were carried out with a mechanical insect collector (D-vac) and time by time with an insect sweep net. The Cicadellidae were either directly aspirated from the net or the entire collection was killed by the mean of a freeze shock at - 25^{o}C. Efforts were made to collect the leafhoppers in habitats that appeared ecologically suited for ***Circulifer*** . However, collections were also done in other habitats and on as many hosts plants as possible.

For identification of ***Circulifer*** species the male genitalia were prepared according to Oman (1949) and finally stored in glycerin.

Results and Discussion

The genus ***Circulifer*** was described by Zakhvatkin (1935) with ***Thamnotettix*** (***Jassus***) ***haematoceps*** (Mulsant and Rey) designated genotype. According to Young and Frazier (1954), the genus includes all deltocephalinae leafhoppers with a biramus aedeagal shaft, the rami of which together form a circle. This genus is also treated as a junior synonymy of ***Neoaliturus*** Distant (Oman et al., 1990).

The *Circulifer* specimens found in Turkey ranged in size from 2.2 mm to 4.0 mm. They were variable in color, often green or yellowish green, sometimes dark greenish, gray or dull yellow.

If the color was green or yellowish green, there were no marks on the body; exceptionally there were two dark spots on pronotum near the vertex. No marks or spots were visible on the forewing, the veins were light yellow or greenish. No dark images were observed on vertex, clypeus, femur or tibia.

If the color was dark greenish, gray or dull yellow, the vertex and pronotum revealed dark spots and parallel dark stripes on clypeus. Some elongated dark marks were visible on the comissural margin of the forewing, and the veins are brown by apex. However, sometimes the veins were even found to be completely brown. On femur and tibia were dark stripes and spots.

Distribution

The genus *Circulifer* was found to be widely distributed and was common in all regions studied. This consists of regions not being irrigated and very dry in summer as well as irrigated areas. *Circulifer* was found at sea level in Adana (Karataş, Yumurtalık), İçel (Silifke, Taşucu), Antalya (Alanya, Antalya, Manavgat) as well as in altitudes up to 2000 m (Ereğli 1020 m, Erzurum 2000 m).

Circulifer species complex

During this study three different *Circulifer* groups were found in Turkey. Dr. M.W. Nielson (Brigham University, Utah, USA), who studied some of our material assigned them tentatively in the *C. haematoceps* complex, the *C. opacipennis* complex and the *C. tenellus* complex (Nielson, 1990, personal communication). Since there was no indication to reject this, the authors followed this assignment for their description of the obtained species complexes.

No differences in coloration or external morphological characters were observed as a value-diagnostic character of different *Circulifer* spp. complexes. Although some individuals differ in size, this character was quite variable and depended on time of collection (Table 1).

For this reason, the species complex of the genus *Circulifer* was determined according to their male genitalia structures. The general feature of the internal male structure, which consists of a biramus aedeaga shaft, one pair of style and a Y- shaped connective is given in figures 1, 2. The pygofer apophysis (Figs. 3, 4) was not considered thoroughly during this study, but might be of some diagnostic value.

The most diagnostic features were found to be the male genitalia plate and the styles. Because of the great variation, the aedeagus provided the least promising character (Oman, 1970). Although other characters like Chaetotaxy and the shape of female pregenital plate might be helpful in determining *Circulifer* species, these features had been avoided due to the lack of comparative material in the literature.

Table 1. Range in size of male and female of different species complexes of the genus *Circulifer* in Turkey.

Circulifer complex	Range in size (mm)	
	Male	Female
C. haematoceps complex	2.8-3.4	3.2-3.9
C. opacipennis complex	2.8-3.5	3.5-4.0
C. tenellus complex	2.2-3.1	2.6-3.6

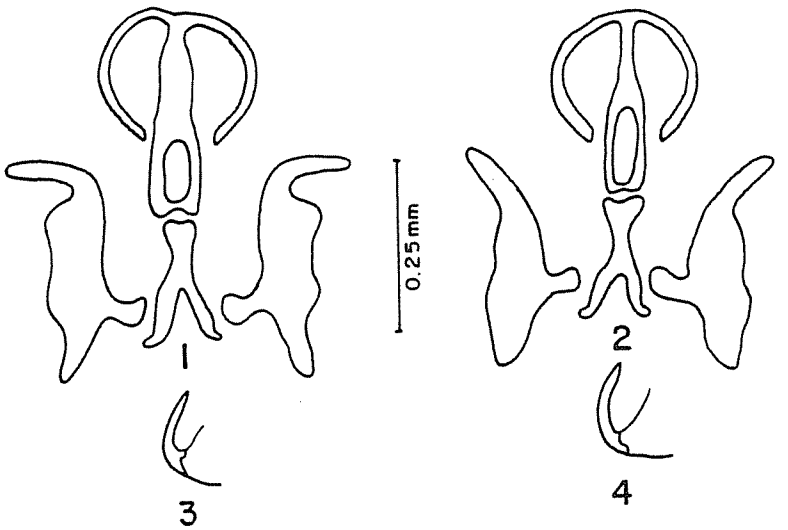

Figure 1-4. Male genitalia of *Circulifer*. 1, Styles, connective and aedeagus (dorsal view) of specimen from Karataş (IX. 1988) on *Salsola kali*; 2, Styles, connective and aedeagus of specimen from Ereğli (X, 1989) on sugar beet; 3, Right pygofer (lateral view) of same specimen as 1; 4, Right pygofer of same specimen as 2.

Aedeagus and style

All species of the genus *Circulifer* revealed a nearly closed biramus aedeagus shaft with only few variations in length and form of the rami (Figs. 5-8; 13-16). Significant differences were found for the shape of the style among *Circulifer*. The apex of the style of *C. opacipennis* complex was truncate, or sometimes rounded, and abruptly directed laterally (Figs. 9-12). Little variation was observed for this character among all individuals of *C. opacipennis* complex.

A similar lateral strongly bent style was described by Young and Frazier (1954) for *C. nausharensis* (Singh-Pruthi), believing the single specimen they studied might be atypical. Later, Bindra et al. (1970) placed *C. nausharensis* in synonymy with *C. opacipennis*, stating that they observed a definite gradient between slightly and abruptly curved apices.

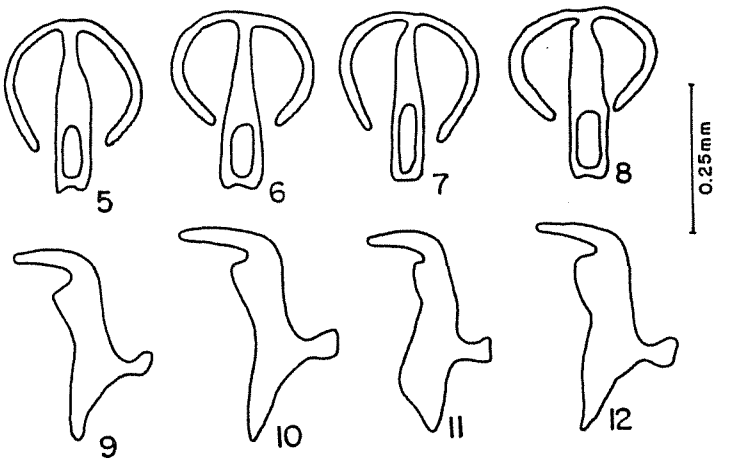

Figure 5-12. ***Circulifer opacipennis*** complex. 5, Aedeagus (dorsal view) of specimen from Karataş (X, 1988); 6, same from Yumurtalık (X, 1989); 7, same from Antalya (IX, 1990); 8, same from Ereğli (IX, 1991); 9, Style (dorsal view) from same specimen as 5; 10, same from same specimen as 6; 11, same from same specimen as 7; 12, same from same specimen as 8. All specimens collected on ***Salsola kali.***

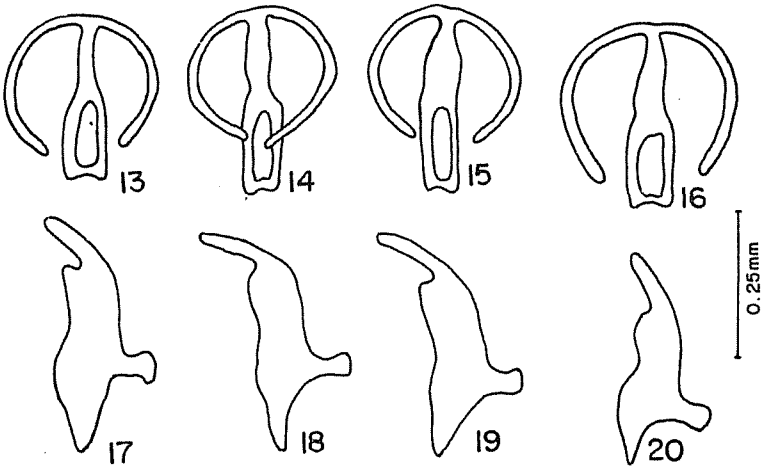

Figure 13-20.***Circulifer haematoceps*** complex. 13, Aedeagus (dorsal view) of specimen from Adana (VII, 1990) on sesame; 14, same from Adana (V, 1990) on maize. ***Circulifer tenellus*** complex . 15, Aedeagus (dorsal view) of specimen from Ereğli (X, 1987) on sugar beet; 16, same from Ereğli (IX, 1991) on sugar beet. ***C. haematoceps*** complex. 17, Style (dorsal view) of same specimen as 13; 18, same of same specimen as 14. ***C. tenellus*** complex. 19, same of same specimen as 15; 20, same of same specimen as 16.

In the ***C.haematoceps*** complex and the ***C.tenellus*** complex the apical extension of the style was never abruptly curved as in ***C. opacipennis*** complex. A gradient was observed between slightly and medium bent apices (Figs. 17-20).

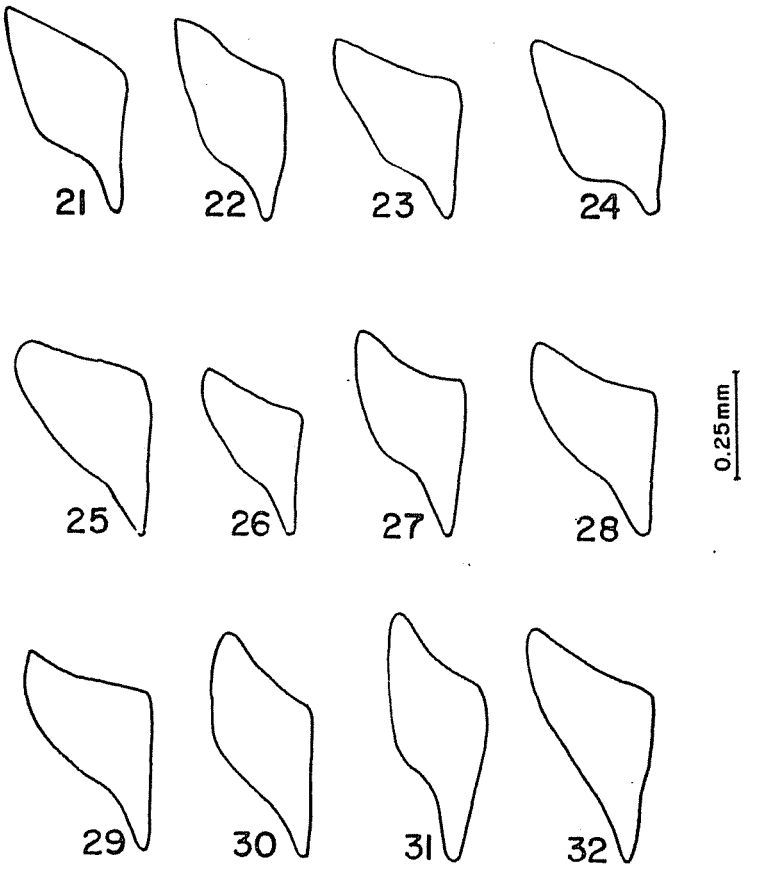

Figure 21-32. ***Circulifer tenellus*** complex. 21, Male genitalia plate (lateral view) of specimen from Ereğli (X, 1987); 22, same from Ereğli (X, 1989); 23, same from Ereğli (IX, 1990); 24, same from Ereğli (X, 1987). All individuals collected on sugar beet. ***Circulifer haematoceps*** complex. 25, Male genitalia plate (lateral view) of specimen from Kahramanmaraş (VII, 1992) on sugar beet; 26, same from Kahramanmaraş (VII, 1992) on sesame; 27, same from Antalya (VII, 1992) on sesame; 28 same from Antalya (VII, 1992) on sesame; 29, same from Antalya (VII, 1992) on sesame; 30, same from Adana (IX, 1990) on sesame; 31, same from Adana (VIII, 1990) on sesame; 32, same from Adana (VII, 1991) on sesame.

Male genitalia plate

Among ***C. haematoceps*** complex and ***C. tenellus*** complex the male genitalia plate seems to have the most diagnostic character. For ***C. tenellus*** complex the plates are described as quadrilateral and for ***C. haematoceps*** complex as triangular (Young and Frazier, 1954). We found that for ***C. tenellus*** the quadrilateral character was rarely obvious (Figs. 21-23) . Only for some individuals was this character as clear as is

shown in figure 24. More often the shape of the plate was somewhat in between quadrilateral and triangulate, but the lateral margins were always more sinuous than for *C. haematoceps* complex (Figs. 21-31). The posterior apex of the plate was always shorter and more distinct for *C. tenellus* complex.

Because the plates were quiet variable, it might be possible that several species are involved in the *C. tenellus* complex. Even hybrids between *tenellus* and *haematoceps* or *opacipennis* might occur, although reproductive isolation between these species is reported (Bindra and Sohi, 1970; Kersting, 1991).

In *C. haematoceps* complex the male genitalia plate was triangulate and the lateral margin wound slightly sinuous to varying degree (Figs. 25-32). The most characteristic plate is shown in figure 32. No differences in shape of the plate were observed between *C. haematoceps* complex and *C. opacipennis* complex.

Distribution and notes on biology

Circulifer haematoceps **complex**

C. haematoceps complex has a wide range of host plants, which consist of monocotyledonous and dicotyledonous plants (Table 2).

The most important summer host of *C.haematoceps* complex was *S.indicum* on which adults and nymphs were commonly found from April/May through end of September. The highest number of individuals were collected on the second sesame crop in late summer. In spring and early summer *C. haematoceps* complex was determined in greater abundance on cotton, maize and potato, but no offspring was observed on these plants. In Kahramanmaraş (Türkoğlu, Narlı) and Hatay (Çınarbaşı) *C. haematoceps* complex was also collected on sugar beet, but only in small numbers. In the Çukurova region the winter hosts were several plant species of Brassicaceae and Chenopodiaceae, e.g. *Raphanus sativus* var. *niger* L. growing as a winter crop in the upper plain of the Çukurova. It was observed that *C.haematoceps* complex overwinter as an adult female in the Çukurova region of Turkey.

In addition to the herein-mentioned host plants, *Artemisia* sp., *Marribium* sp., *Medicago sativa* L., *Micromeria* sp., *Phaseolus vulgaris* L., *Plantago* sp., *Polygonum* sp, *Salcicornia* sp. and *Thymus* sp. are listed as host plants by Young and Frazier (1954), Kalkandelen (1974), and Lodos and Kalkandelen (1985). During this study the authors failed to collect *C. haematoceps* complex on *Cistus* sp., *Rosmarinus officinalis* L. and other plant species of the macchia vegetation, although these plants are given as hosts by Young and Frazier (1954) in Spain and Italy.

C. haematoceps complex was widely distributed. It occurred in the subtropical zone along the Mediterranean coast in Adana, Antalya, Hatay and İçel as well as in the submediterranean climatic zone of Adıyaman, Diyarbakır, Kahramanmaraş, and Şanlıurfa, as well as in the continental climate zone of Mardin and Siirt. Even in the wintercold climate of Erzurum in the North East of Turkey, *C. haematoceps* complex was collected on potato and sugar beet in July 1991. Özbek et al. (1987) reported a high abundance of this species on potato in Erzurum in summer 1986 and 1987. Dlabola (1971) mentioned this species as a typical leafhopper of the dry salt steppe habitat.

Table 2. Host plants of ***Circulifer haematoceps*** complex at different locations in Turkey.

Family Species	Location (Provinces)
Amaranthaceae	
Amaranthus graecizanz L.	Adana
Amaranthus sp.	Adana
Apocynaceae	
Catharanthus roseus L.	Adana, İçel
Brassicaceae	
Brassica napus L.	Adana
Brassica sp.	Adana
Raphanus raphanistrum L.	Adana
Raphanus sativus var. ***niger*** L.	Adana
Sinapis arvensis L.	Adana
Chenopodiaceae	
Beta vulgaris L.	Adana, Kahramanmaraş, Erzurum
Chenopodium album L.	Adana
Chenopodium sp.	Adana
Spinacia oleracea L.	Adana
Compositae	
Helianthus annuus L.	Diyarbakır
Cucurbitaceae	
Citrullus lanatus (Thunb.)	Adana
Cucumis sativus L.	Diyarbakır
Cyperaceae	
Cyperus rotundus (L.)	Adana
Malvaceae	
Gossypium hirsutum L.	Adana, Diyarbakır
Mimosaceae	
Prosopis stephaniana Kunth	Adana
Pedaliaceae	
Sesamum indicum L.	Adana, Antalya, Gaziantep, Hatay İçel, Kahramanmaraş, Şanlıurfa
Poaceae	
Sorghum halepense (L.)	Adana
Zea mays L.	Adana, Adıyaman, Diyarbakır, Gaziantep, Mardin, Siirt, Şanlıurfa
Portulacaceae	
Portulaca oleracea L.	Adana
Solanaceae	
Capsicum annuum L.	Şanlıurfa
Lycopersicon lycopersicum (L.)	Diyarbakır
Nicotiana tabacum L.	Diyarbakır
Solanum melongena L.	Şanlıurfa
Solanum tuberosum L.	Adana, Erzurum

C. haematoceps complex was found at sea level and in altitudes of up to 2000 m. Young and Frazier (1954) listed this species from Polatlı, Ankara and Tuz Gölü, and Lodos and Kalkandelen (1985) collected unlimited specimens all over Turkey.

Circulifer opacipennis complex

Adults and nymphs of *C. opacipennis* complex were collected starting from April (adults) through December/January only on *Salsola kali* L.(Chenopodiaceae). On other plants of the same sandy dune habitat, e.g. *Alhagi* sp. *Echinophora spinosa* L. , *Echium* sp. the leafhopper was not found, even if its host plant *S. kali* was dried. In early spring only females were collected. The population peaked late in season in September/October, when sometimes up to 100 individuals per plant were sampled. In 1990/1991 *C. opacipennis* complex females were found throughout the winter, indicating that they overwinter as adult, likely as mated females.

The distribution pattern of *C. opacipennis* complex was remarkably similar to its host plant *S. kali*. Since *S. kali* is commonly grown on the sandy dunes along the sea shores, this leafhopper was found in Adana (Karataş, Tuzla, Yumurtalık), İçel (Silifke, Taşucu), and Antalya (Alanya, Central province Manavgat). On a single stand of *S. kali* adjacent to a sugar beet field in Ereğli (Konya plain, 1000 m), high numbers of *C. opacipennis* complex were collected in September 1991.

It is interesting that this species was never found on any other host plant than *S. kali*, even if suitable host plants of *Circulifer* grew in the same habitats. Our results confirm the findings of Klein and Raccah (1991), who proved that *C. opacipennis* complex is only able to reproduce on *S. kali* and not on the several other hosts plants serving at least as moderate host plant of *C. haematoceps* complex.

In opposite to Klein and Raccah (1991), it was found that *C. opacipennis* complex stays alive on sugar beets at room temperature in laboratory, but the number of nymphs was very low. After more than 18 months on sugar beet the number of offspring increased significantly. It was not possible to rear this leafhopper on other host plants, e.g. *Matthiola incana* L. (Brassicaceae).

Circulifer tenellus complex

During this study *C. tenellus* complex was only collected on sugar beets in the Konya plain around Ereğli. Frazier (1953) listed *C. tenellus* complex from Turkey, but not in a great abundance, and sometimes limited by undetermined factors. The highest population was observed at the end of the season in October/November. Although only found on sugar beet, it is likely that *C. tenellus* complex has a wider range of host plants, especially Chenopodiaceae and Brassicaceae which occur commonly as weeds in sugar beet stands. In laboratory *C. tenellus* complex multiplied best on sugar beet and *M. incana*, but produced only a few offspring on sesame. On pepper and tomato adult leafhoppers died within seven days and no offspring was observed.

Conclusion

Although the genus *Circulifer* was carefully studied previously by Oman (1948, 1970) and Young and Frazier (1954), there are still a lot of different names and/or

synonyms available. ***C. opacipennis*** and ***C. haematoceps*** are often used contemporarily by scientists (e.g. Dlabola, 1971; Kalkandelen, 1974; Lodos and Kalkandelen, 1985; Fos et al., 1986; Oldfield, 1987). According to our results, the name ***C. opacipennis*** as synonym of ***C. haematoceps*** should be avoided, mainly because this taxon never showed any strong lateral bent apex of the style as was typical for the ***C. opacipennis*** complex in Turkey. But not only in Turkey: Klein and Raccah (1988, unpublished data) were able to determine a distinct species on ***S. kali*** in Israel, showing this abruptly directed lateral apex. But due to the confusion in taxonomic and nomenclature of the genus ***Circulifer***, it seems not to be reasonable to describe this population as a new species, unless this genus had been revised.

During our studies we found no evidence, neither in the ***C. haematoceps*** complex nor in the ***C. opacipennis*** complex that more than one species each was involved. The great variation of the genitalia plate among the ***C. tenellus*** complex indicated that more than one species or even hybrids might exist. Our results strongly showed that the taxonomic and nomenclature of the genus ***Circulifer*** has to be resolved more clearly. The future studies should conduct of cross breeding experiments and even biochemistry investigations to solve the species problem in this genus, including at least two major agricultural pests.

Özet

Türkiye' deki *Circulifer* Zakhvatkin (Homoptera: Cicadellidae) türlerinin taksonomisi, yayılışı ve konukçuları üzerinde çalışmalar

Beş yıl süreyle yürütülen bu çalışmada ***Circulifer*** cinsine ait Türkiye' de üç farklı tür kompleksi saptanmıştır.

Circulifer haematoceps (Mulsant and Rey) kompleksinin erkek bireyleri üçgen şeklinde genital plakalara ve apeksi hafifçe laterale doğru kıvrılmış style' lere sahiptirler. Bu tür kompleksi oldukça geniş bir yayılış alanına sahip olup, aynı zamanda 27 konukçusu belirlenmiştir. ***Circulifer opacipennis*** (Lethierry) kompleksi erkek bireyleri ise üçgen şeklinde genital plakalara ve apeksi çok belirgin bir şekilde laterale doğru kıvrılmış style' lere sahiptirler. ***Salsola kali*** L. bu türün tek konukçusu olarak bulunmuştur. Bu nedenle, ***C. opacipennis***'in yayılışıda konukçusu ***S. kali*** 'nin yayılışı ile bir benzerlik göstermiştir. Bu iki tür kompleksinden herbirinin farklı türler içerdiğine dair herhangi bir bulgu yoktur. ***Circulifer tenellus*** (Baker) kompleksi erkek bireylerine ait genital plakaların şekli dikdörtgen benzeri olmakla birlikte, bireyler arasında büyük bir değişkenlik göstermiştir. Style'lerin apeksi ise hafifçe laterale doğru kıvrılmıştır. ***C. tenellus*** kompleksi sadece Ereğli (Konya ovası)'deki şekerpancarı tarlalarında saptanmıştır. Erkek genital plakalardaki değişkenlik nedeniyle bu tür kompleksi içerisinde birden fazla tür yada hibrid olabileceği düşünülmektedir.

Bu çalışmanın sonucunda ***Circulifer*** cinsinin ayrıntılı bir şekilde çalışılarak, bu cinsin yeniden gözden geçirilmesinin gerekliliği ortaya konulmuştur.

Acknowledgement

The authors want to express their thanks to the Turkish Scientific and Technical Research Council (TÜBİTAK) and to the Stiftung Volkswagenwerk FRG, partly supporting this study. Ulrich Kersting greatfully acknowledges his scholarship from the Humboldt-Stiftung, Feodor-Lynen-program, FRG.

Literature

Bennett, C.W. and A. Tanrısever, 1957. Sugar beet curly top disease in Turkey. **Plant Dis. Rep., 41:** 721-725.

Bindra, O.S. and A.S. Sohi, 1970. Cross-breeding experiments between ***Circulifer opacipennis*** (Lethierry) and ***C. tenellus*** (Baker), Cicadellid vectors of sugar beet curly top virus. **Indian J. Entomol., 32:** 183-184.

Bindra, O.S., S. Singh and A.S. Sohi, 1970. Taxonomy and distribution of Indian species of ***Circulifer*** homoptera cicadellidae. **Ann. Ent. Soc. Am., 63:** 664 - 667.

Dlabola, J., 1971. Taxonomische und chorologische Ergaenzungen der Zikadenfauna von Anatolien, Iran, Afganistan und Pakistan (Homoptera, Auchenorrhyncha). **Acta Ent. Bohem., 68:** 377-396.

Fos, A., J.M. Bove, J. Lallemand, C. Saillard, J.C. Vignault, Y. Ali, P. Brun and R. Vogel, 1986. The leafhopper ***Neoaliturus haematoceps*** is a vector of ***Spiroplasma citri*** in the Mediterranean area. **Ann. Inst. Pasteur Microbiol., 137a,** 97 - 107.

Frazier, N.W., 1953. A survey of the Mediterranean region for the beet leafhopper. **J. Econ. Entomol., 46:** 551-554.

Kalkandelen A., 1974. Orta Anadolu'da Homoptera: Cicadellidae familyası türlerinin taksonomileri üzerinde araştırmalar. Zirai Mücadele ve Karantina Genel Müdürlüğü, Araştırma Eserleri Serisi, 221 pp.

Kersting, U., 1991. Untersuchungen über Wirtspflanzenspektrum und Insektenvektoren sowie Nachweismethoden des Erregers der Zitrusstauche, ***Spiroplasma citri*** Saglio et al., im Zitrusanbaugebiet der Südtürkei. Dissertation der Universitaet Bonn, FRG, 97 pp.

Kersting, U. and Ç. Şengonca, 1992. Detection of insect vectors of the citrus stubborn disease pathogen, ***Spiroplasma citri*** Saglio et al., in the citrus growing area of South Turkey. **J. Appl. Ent. 113:** 356 - 364.

Kersting U., Ç. Şengonca and A. Çınar, 1992. Detection of citrus stubborn disease pathogen, ***Spiroplasma citri*** Saglio et al., in different host plants and in their associated leafhopper vectors in the citrus growing area of South Turkey. **FAO Plant Prot. Bull. 40** (3). (*in press*).

Kheyri, M., 1969. The leafhoppers of sugarbeet in Iran and their role in curly-top virus disease. Sugarbeet Seed Institute, Karaj, Entomological Research Division, Teheran, 30 pp.

Klein, M. and B. Raccah, 1991. Seperation of two leafhopper populations of the ***Circulifer haematoceps*** complex on different host plants in Israel. **Phytoparasitica, 19:** 153-155.

Lodos N. and A. Kalkandelen, 1985. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey. XVII. Family - Cicadellidae: Deltocephalinae: Grypotini, Goniagnathini and Opsiini (Part I). **Turkish J. Plant Protection, 9:** 79-90.

Oldfield, G. N., 1987. Leafhopper vectors of citrus stubborn disease pothogen, ***Spiroplasma citri*** . In: Proc. R.O.C. United States Cooperative Science Seminar on Mycoplasmology Diseases of Plants (NSC Symposium Series No.1, Republic of China), 119-124.

Oman, P.W., 1948. Notes on the beet leafhopper, ***Circulifer tenellus*** (Baker), and its relatives (Homoptera: Cicadellidae). **J. Kans. Ent. Soc., 21** (1): 11-14.

Oman, P.W., 1949. The nearctic leafhoppers (Homoptera: Cicadellidae) a generic classification and check list. **Mem. Ent. Soc. Washington, 3**: 253 pp.

Oman, P.W., 1970. Taxonomy and nomenclature of the beet leafhopper, ***Circulifer tenellus*** (Homoptera: Cicadellidae). **Ann. Ent. Soc. Am., 63:** 507-512.

Oman, P.W., W.J. Knight and M.W. Nielson, 1990. Leafhopper (Cicadellidae): A bibliography, generic check-list and index to the world literature 1956-1985. CAB International Institute of Entomology, Wallingford, UK., 368 pp.

Özbek, H., Ö. Alaoğlu and Ş. Güçlü, 1987. Homopterous species on potatoes in Erzurum province in Turkey. **Türkiye I. Ent. Kong. Bildirileri, İzmir, 13. -16. October,** 219-228.

Young D.A. and N.W. Frazier, 1954. A study of the leafhopper genus **Circulifer** Zakhvatkin (Homoptera: Cicadellidae). **Hilgardia, 23:** 25-52.

Zakhvatkin, A.A., 1935. Note on Homoptera-Cicadina of Jemen. **Moscow State Univ. Sci. Proc., 4:** 106-115.