

Laboratory studies on the effect of different sesame cultivars on reproduction and host plant selection of *Circulifer haematoceps* (Mulsant et Rey) (Homoptera, Cicadellidae)

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Summary

The effect of four different Turkish sesame cultivars on reproduction and host plant selection of *Circulifer haematoceps*, an important leafhopper vector in the East Mediterranean region was studied at a constant temperature of $35 \pm 1^\circ\text{C}$ in laboratory.

The average number of eggs laid per leafhopper female within 15 days and the average number of eggs laid per day were significant higher for cv. Gölarmara (154.2 eggs, 11.8 eggs/day) compared to the three other cultivars. The lowest number of eggs per day and within 15 days were laid on cv. Özberk-82 and cv. Çamdibi, averaging 5.4 eggs/day and 70.2 eggs/female, and 5.3 eggs/day and 77.6 eggs/female, respectively. The highest net reproductive rate (R_0) was calculated for *C. haematoceps* individuals kept on cv. Gölarmara (89.59 females/female), followed by cv. Mrganlı, cv. Çamdibi, and cv. Özberk-82 valuing between 70.95 and 40.72 females/female. *C. haematoceps* ovipositing on cv. Gölarmara displayed the highest intrinsic rate of increase ($r_m = 0.783$), while for those females caged on cv. Çamdibi and cv. Özberk-82 comparable low r_m -values of 0.560 and 0.558 were calculated. In the host plant choice tests, *C. haematoceps* females preferred significantly cv. Mrganlı for laying eggs (57.0%), followed by cv. Gölarmara averaging 29.8%. Significant lower was the egg-laying rate on cv. Özberk-82 and cv. Çamdibi valuing 9.0% and 4.2%, respectively.

The population growth parameters and the results of the choice experiments revealed significant differences among the four sesame cultivars tested. The results for cv. Çamdibi and cv. Özberk-82 gain evidence for resistant factors in these cultivars that may be used for defense against *C. haematoceps*.

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Introduction

Sesame (*Sesamum indicum* L.) is an important summer crop grown along the Mediterranean coast and in South-East Turkey. Several leafhoppers species are associated with sesame (Başpınar et al., 1993b). However, only *Circulifer haematoceps* (Mulsant et Rey) (Homoptera, Cicadellidae) which is a common leafhopper species on sesame in Turkey (Lodos and Kalkandelen, 1985; Başpınar et al., 1993a) causes serious damage by vectoring at least two destructive plant pathogens in sesame.

Spiroplasma citri Saglio et al. is a most serious disease of citrus and sesame in the Eastern Mediterranean region (Kersting et al., 1992). Sesame is considered as a most important inoculum source of the citrus stubborn disease pathogen, *S. citri*, and *C. haematoceps* is the principle vector of this pathogen in the Eastern Mediterranean region (Kersting and Şengonca, 1992; Kersting et al., 1993).

The sesame phyllody MLO is a disease of sesame wherever this plant is grown (Vasudiva and Sahambi, 1959; Cousin et al., 1970; Choopanya, 1973; Klein, 1977; Türkoğlu and Fidan, 1985; Salehi and Izadpanah, 1992; Kersting, 1993). The causal pathogen is transmitted by the leafhopper *Orosius orientalis* (Matsumura) (Homoptera, Cicadellidae) in Asia and Africa (Laboucheix et al., 1972; Ishihara, 1982). This leafhopper is also a common species on sesame in Turkey (Başpınar et al., 1993b). In Turkey, however, *O. orientalis* was not capable to transmit the sesame phyllody pathogen and *C. haematoceps* was found as the principle vector of this MLO (Kersting, 1993).

The spread of insect-transmitted pathogens depends on the abundance of insect vectors and their interplant movement, the tenure time on plants and the mode of pathogen transmission (Irwin and Rueskin, 1986; Power, 1990). The use of cultivar resistance affecting the vector host plant preference and/or vector population growth was proved useful in limiting the spread of leafhopper transmitted diseases in several major field and forage crops such as cotton, rice, potato, and alfalfa (Gardner et al., 1945; Tingey, 1985).

The objectives of this study were to evaluate Turkish sesame germ plasm for potential resistance influencing the population growth and host plant selection of *C. haematoceps* in laboratory.

Material and Methods

C. haematoceps were reared on six to twelve weeks old sugar beet plants at $27 \pm 3^\circ\text{C}$ temperature, $70 \pm 5\%$ relative humidity and 16 hours of artificial light in a climate room. Every four to five weeks new sugar beet plants were placed in the rearing cages to maintain the culture (Şengonca et al., 1991).

For the experiments four Turkish sesame cultivars were selected: Gölarmara, Çamdibi, Muganlı, and Özberk-82. The sesame plants were grown in a sterile potting mixture of sand, tuff and peat (1:1:1) in a climate room at the same conditions as described above. Plants were used for the experiments about six to eight weeks after sowing, when they were at least eight leaves.

To construct fecundity tables of *C. haematoceps* on different sesame cultivars at constant temperature, one newly hatched male and female were transferred from the mass rearing into a clip cage (\varnothing 2.0 cm) fixed on a leaf of one of the four sesame varieties. Every day the clip cages were fixed onto new leaves. Leaf disks were cut out from the elder leaf and the number of eggs laid per female were recorded under a binocular microscope (x 40) while the leaf disk was illuminated from underneath. For each sesame cultivar ten replications were set up. The experiments were carried out at $35 \pm 1^\circ\text{C}$, $70 \pm 5\%$ relative humidity with 16 h of artificial light in a climate chamber. After 15 days, the experiments were terminated since until that time and at the chosen temperature of 35°C , the maximum peak in egg laying of *C. haematoceps* has already passed (Kersting, 1991). Demographic parameters (R_0 , r_m) were constructed from fecundity tables according to Southwood (1978).

The acceptance of the four different sesame cultivars as breeding host for *C. haematoceps* was studied in choice tests by offering one sesame plant of each cultivar simultaneously for oviposition. The sesame plants were of same age (6 weeks) and same size. 50 *C. haematoceps* females, randomly selected from the mass rearing were released into the cage for a 24 h oviposition period. Four days later the sesame plants (stem and leaves) were cut in 5 cm sections and eggs were visualized by staining as described by Backus (1988). Number of eggs was counted under a binocular microscope (x 40) with light from underneath. This experiment was repeated three times using 50 new *C. haematoceps* females for each repetition and conducted at $27 \pm 3^\circ\text{C}$, $70 \pm 5\%$ relative humidity under 16:8 h light:dark photoperiod in a climate chamber.

Results and Discussion

The average number of eggs laid per *C. haematoceps* female within 15 days (154.2 eggs) and the average number of eggs laid per day (11.8 eggs/day) were significant higher for cv. Gölarmara compared to the three other sesame cultivars. The lowest number of eggs per day and within 15 days were laid on cv. Özberk-82 and cv. Çamdibi, averaging 5.4 eggs/day and 70.2 eggs/female, and 5.3 eggs/day and 77.6 eggs/female, respectively (Table 1).

Table 1. Fecundity of *Circulifer haematoceps* on four different sesame cultivars within 15 days at $35 \pm 1^\circ\text{C}$ (n = 10)

Sesame cultivar	No. of eggs/female/day		Total No. of eggs laid/female	
	Mean \pm SE	min-max	Mean \pm SE	min-max
Çamdibi	5.3 \pm 0.80 c	0 - 8	77.6 \pm 12.43 b	0 - 125
Gölarmara	11.8 \pm 0.95 a	5 - 16	154.2 \pm 19.33 a	28 - 238
Muganll	9.0 \pm 0.51 b	7 - 12	122.0 \pm 12.55 a	56 - 179
Özberk-82	5.4 \pm 0.35 c	4 - 8	70.2 \pm 7.27 b	40 - 107

*Means in column followed by the same letter are not significantly different at the 5% level (Tukey's HSD Multiple Range Test)

The daily number of eggs laid per female on each sesame cultivar, assuming a sex ratio of 58% females (Kaur et al., 1971), was used to construct fecundity tables. From these tables the net reproductive rates (R_0) and the intrinsic rates of increase (r_m) were calculated. The results are summarized in Figure 1, presenting the demographic parameters as well as the course of the survival rate (l_x) and the number of female progeny (m_x) for each sesame cultivar.

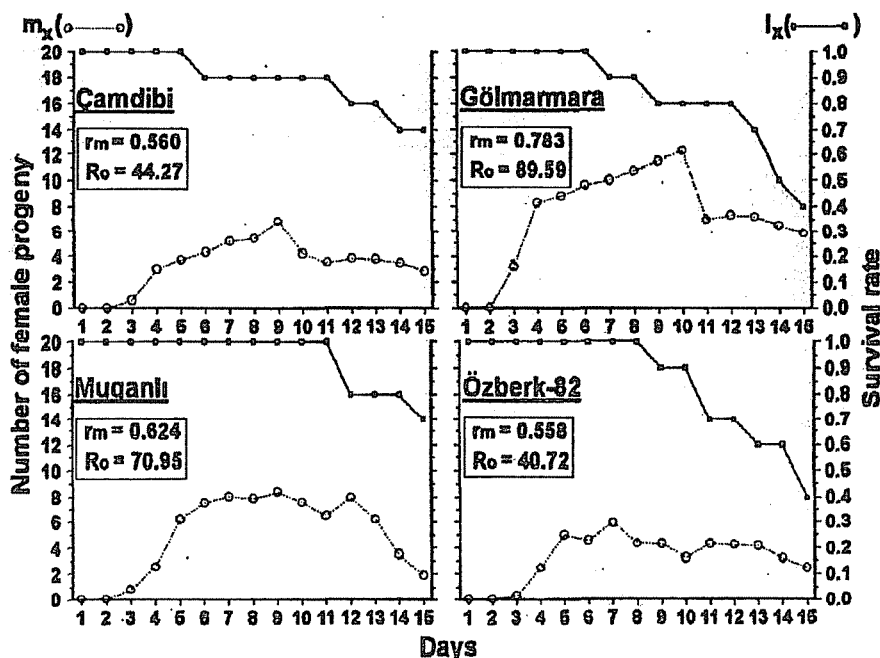


Figure 1. Number of female progeny and survival rate of *Circulifer haematoceps* on four different sesame cultivars at $35 \pm 1^\circ\text{C}$ in laboratory

The maximum number of eggs/day and *C. haematoceps*-female was laid between the 7th day (cv. Özberk-82) and the 10th day (cv. Göl marmara). Till the end of the observation period the number of female progenies per day and female dropped considerably and ranged between 1.87-5.87 females/female. The highest net reproductive rate was calculated for leafhopper individuals kept on cv. Göl marmara (89.59 females/female), followed by cv. Mugañlı, cv. Çamdibi, and cv. Özerberk-82 valuing between 70.95 and 40.72 females/female. *C. haematoceps* ovipositing on cv. Göl marmara displayed the highest intrinsic rate of increase ($r_m = 0.783$), while for those females caged on cv. Çamdibi and cv. Özberk-82 comparable low r_m -values of 0.560 and 0.558 were calculated.

Demographic life-tables are generally constructed including egg incubation period, the developmental time and the total life time of a species. In these particular

experiments, the developmental time, mortality during egg stage and immature stages as well as age specific reproduction and survival rate for most of the *C. haematoceps* life-span, which is reported to last 28.7 days at 35°C on sugar beet (Şengonca et al., 1991) were omitted. The reason for not including the total longevity of the leafhopper lays in the fact that many insect species display steep cumulative $L_x m_x$ -curves early in adult life that flatten out after passing the peak in oviposition (for a detail discussion refer to Southwood, 1978 page 372-374). This is also true for *C. haematoceps*, especially at warm temperatures where the maximum number of eggs/female is laid about 10-12 days after hatching (Kersting, 1991). Thus, the number of female progenies after the 15th day contributes less to the total R_0 and r_m values. The significant differences in important population parameters obtained among the four sesame cultivars in this study proved the suitability of this assumption.

Differences in the host plant selection of *C. haematoceps* may contribute a lot in reducing its population density on sesame. In the host plant choice tests, *C. haematoceps*-females preferred significantly cv. Muganlı for laying eggs (57.0%), followed by cv. Gölmarмара averaging 29.8% (Fig. 2). Significant lower was the egg-laying rate on cv. Özberk-82 and cv. Çamdibi valuing 9.0% and 4.2%, respectively.

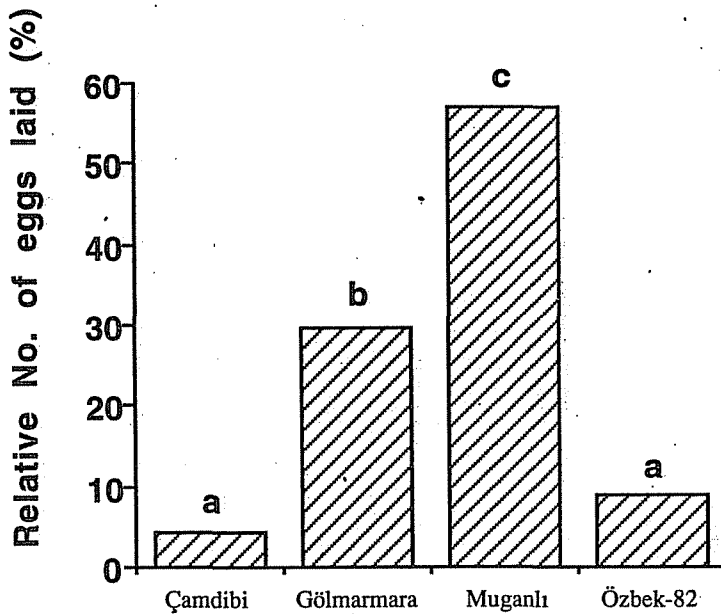


Fig 2. Relative number eggs laid by *Circulifer haematoceps* females on four different sesame cultivars in a choice test at 27 ± 3 °C in laboratory

The parameters describing the population growth and results of the choice experiments proved that there are significant differences among the four sesame cultivars tested. The highest r_0 and r_m values of *C. haematoceps* were obtained for cv.

Gölmarmara and cv. Muganlı, which were also the preferred hosts for oviposition. In opposite, the results for cv. Çamdibi and cv. Özberk-82 gain evidence for resistant factors in these cultivars that may be used for defense against *C. haematoceps*.

No serious attempts were made to identify the nature of these resistance phenomena. Epidermal morphology characteristics like trichomes create mechanical barriers and limit the access to preferred feeding and oviposition sites. Moreover, trichomes interfere with locomotion and attachment to the plant, or physically entrap leafhoppers. Three types of trichomes have been linked with resistance to leafhoppers in major crop plants (Tingey, 1985). However, differences in number of trichomes, hairs or other epidermal characteristics were not observed among the four sesame cultivars studied.

Beside morphological characteristics, allelochemical defenses have been implicated as defensive agent against leafhoppers. Potato glycoalkaloids contents in *Solanum* species were highly inversely correlated with field infestation of *Empoasca fabae* (Harris) (Homoptera, Cicadellidae) (Tingey et al., 1978). *E. fabae*-nymphs fed on diets containing glycoalkaloid fractions extracted from wild potato species revealed a significant shorter nymphal survival than the control group (Raman et al., 1979).

Although the specific defense mechanisms among different sesame cultivars are not known, further studies may identify plant factors and mechanisms conferring resistance and characterize their defense impact on *C. haematoceps* biology. In view of the importance of *C. haematoceps* as vector of plant pathogens in sesame, the relationship between varietal resistance and disease management must be considered.

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Özet

***Circulifer haematoceps* (Mulsant et Rey) (Homoptera, Cicadellidae) 'in farklı susam çeşitlerini tercihi ve bunlar üzerindeki üreme güçlerinin laboratuvar koşullarında incelenmesi**

Doğu Akdeniz Bölgesi'nde önemli bir vektör olan *Circulifer haematoceps*'e dört farklı susam çeşidinin etkileri laboratuvar koşullarında 35 ± 1 °C' deki sabit sıcaklıkta denenmiştir.

C. haematoceps dişilerinin 15 günlük süre içinde ve günlük ortalama bıraktığı yumurta sayısı, diğer üç çeşit ile karşılaştırıldığında, Gölmarmara çeşitinde önemli oranda yüksek bulunmuştur (154.2 yumurta/dişi, 11.8 yumurta /gün). Günlük ve 15 gün içinde en az yumurta Özberk-82 (5.4 yumurta/gün, 70.2 yumurta/dişi) ve Çamdibi (5.3 yumurta/gün, 77.6 yumurta/dişi) çeşitleri üzerine bırakılmıştır. Gölmarmara çeşitinde *C. haematoceps* 'in net üreme gücü (R_0) 89.59 dişi/dişi ile en yüksek olarak bulunmuş, diğer çeşitlerde ise bu değer 70.95 ila 40.52 dişi/dişi arasında değişmiştir. Kalıtsal üreme kapasitesi (r_m), yine Gölmarmara çeşitinde (0.783) en fazla olmuş, Çamdibi (0.560) ve Özberk-82 (0.558) çeşitleri ise düşük düzeylerde kalmıştır. Konukçu bitki seçim denemelerinde, *C. haematoceps* dişileri yumurta bırakmak için büyük

ölçüde Munganlı (% 57.0) ve Gölarmara (% 29.8) çeşitlerini tercih etmişler, bunları sırasıyla Özberk-82 (% 9.0) ve Çamdibi (% 4.2) çeşitleri izlemiştir.

Populasyon büyüme parametreleri ve konukçu tercihi açısından dört susam çeşiti arasında önemli derecede farklılıklar görülmüştür. Elde edilen verilere göre Çamdibi ve Özberk-82 çeşitlerinin *C. haematoceps* 'e karşı dayanıklılık gösterdiği sonucuna varılmıştır.

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