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Role of visual and auditory cues in mating behavior of two desert species of *Drosophila*[1]

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Summary. The effects of visual and auditory cues on mating behavior was examined for 2 members of the *Drosophila nannoptera* species group. Results indicate that visual and auditory signals do not play a significant role in mating success in *Drosophila acanthoptera* and *D.* species W.

Visual, auditory, and olfactory cues are 3 major forms of stimuli affecting mating behavior in *Drosophila.* Bennet-Clark and Ewing[2] indicated that auditory cues are essential to stimulate the courtship of wingless males. Manning[3] reported that reduction in mating frequency was observed when the aristae and funiculi of the female (which function as receivers of auditory cues), were removed or immobilized. Petit and Nouaud[4] however, obtained results which indicated a nonessential role of auditory cues in stimulating courtship.

Averhoff and Richardson[5,6] found that airborne chemosignals are necessary for the initial stages of male courtship in *D. melanogaster.* Wingless males behaved as normal males and courted females when exposed to airborne chemosignals. The existence of sex pheromones in *D. pseudoobscura* have also been found[7,8].

Spieth[9] has found that other environmental cues such as visual signals and tactile sensations are also important in mating behavior. Some species of *Drosophila* are light-dependent with respect to their mating and oviposition behaviors.

Preliminary experiments were set up to examine the effects of visual and auditory cues on mating behavior of 2 members of *Drosophila nannoptera* species group. The *nannoptera* species group consists of 4 species. *D. pachea* is distributed throughout the Sonoran desert of southwestern Arizona, northwestern Mexico, and Baja California. The other 3 species (*D. nannoptera, D. acanthoptera* and species W) are sympatric in arid habitats of Guatemala and the Southern Mexican states of Oaxaca and Puebla. This study focuses on *D. acanthoptera* and species W.

Materials and methods. Both species W and *D. acanthoptera* were collected from rotting cactus tissue in Ixtepec, Oaxaca, Mexico and designated strains A585.1b and A585.2b, respectively. Inbred lines were established for each species by pair mating brothers and sisters for 7 generations. Upon eclosion, males and females were separated and aged to 2 days. To test for the role of visual cues, 60 pairs of a brother and sister were placed in total darkness while another 60 pairs were placed in an environment of 12 h of light and 12 h of darkness. To test for the role of auditory cues, 30 males from each of the above 2 environments were dewinged with ultramicro surgical scissors. For each species 120 brother-sister pair matings were examined. One male and female were placed in a 2.5 cm diameter × 9.5 cm high glass specimen tube containing 7 ml of our standard laboratory *Drosophila* media. All pair matings remained at 25 °C in their particular environments for 17 days after which the specimen tubes were examined for the presence of fertilized eggs. A successful mating was one that had larvae present within 17 days after the pair mating had been set up.

Results. Table 1 shows the effects of visual and auditory cues on successful matings in *D. acanthoptera.* Although a decline in the number of successful matings occurs when pairs are kept in the dark or when males are dewinged, a contingency chi-square test ($\chi^2 = 2.78$, d.f. = 3) indicates no significant differences between pairs of different treatments.

Table 2 shows test results for *D.* species W. A slight increase in the number of successful matings was found for pair matings kept in total darkness. However, a contingency chi-square test ($\chi^2 = 0.663$, d.f. = 3) indicates no significant differences between pairs of different treatments.

Discussion. The experiments show that *D. acanthoptera* and *D.* species W are not lightdependent with respect to mating

Table 1. Effects of visual and auditory cues on successful matings in *Drosophila acanthoptera*

Treatment	N*	Successful matings (%)
12-h light: normal pairs	30	70.0
Total darkness: normal pairs	30	63.3
12-h light: dewinged males	30	50.0
Total darkness: dewinged males	30	56.7

* N equals number of brother-sister pair matings set up.

Table 2. Effects of visual and auditory cues on successful matings in *Drosophila* species W.

Treatment	N*	Successful matings (%)
12-h light: normal pairs	30	60.0
Total darkness: normal pairs	30	63.3
12-h light: dewinged males	30	53.3
Total darkness: dewinged males	30	60.0

* N equals number of brother-sister pair matings set up.

behavior. Although auditory stimuli cannot be eliminated, it has been shown that wingless males are as successful in mating as winged, normal males. It is well established that wings are a major source of auditory communication signals in *Drosophila.*

Similar findings occur in *D. pachea* which is allopatric to the other species of the *nannoptera* species group[10]. *D. pachea* is as successful in mating in total darkness as in light conditions. Wingless males of *D. pachea* are highly successful in courting females, and successfully inseminate them. There is strong indication that olfactory cues are very important in *D. pachea*[10]. However, olfactory cues have not been examined yet for *D. acanthoptera* and species W. Averhoff et al.[11] have reviewed the literature concerning the roles of different modes of communication which may be involved in mate selection in *Drosophila,* and argue that olfactory cues may be more important in *D. melanogaster* than the literature indicates. Although the reasons are not clear, one feature that is more characteristic of desert-dwelling species of *Drosophila* is the significant reduction in the number of successful pair matings versus mass matings (5–10 adults of each sex)[10,12].

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Relations phénétiques entre les familles d'Hamamelididae

Phenetic relationships between the families of the Hamamelididae

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Summary. The phenetic relationships between the families of the Hamamelididae subclass were studied by using the following multifactorial analytical methods: principal components analysis (PCA) and reciprocal averaging (RA). The results obtained agree appreciably with Takhtajan's classification system.

La taxonomie numérique est utilisée régulièrement au niveau de l'espèce et moins fréquemment à celui du genre. Cependant, elle est rarement employée pour comparer les familles de plantes entre elles[3,4]. La principale raison réside probablement dans le fait qu'il est très difficile d'organiser les caractères de façon à exprimer totalement la variabilité qui existe souvent au niveau de ce taxon. En effet, la notion de présence ou absence d'un caractère ne donne pas une image réelle de certaines familles de plantes à fleurs. Afin de contourner cet obstacle nous avons utilisé la fréquence du caractère à l'intérieur de la famille.

Matériel et méthode. Notre étude porte sur la sous-classe des Hamamelididae, sensu Takhtajan[2], qui comprend 22 familles. Pour la plupart des familles, 40 caractères morphologiques et anatomiques ont été recensés. Néanmoins, pour certaines familles mal connues, nous avons dû nous limiter à un minimum de 35 caractères, par exemple, les Didymelaceae (35 caractères), les Barbeyaceae (36 caractères), les Balanopaceae (37 caractères). Notons que, dans nos ordinations 130 états ou modalités de ces caractères ont été utilisés. La fréquence d'un état de caractère, dans chaque famille, est obtenue en calculant le pourcentage de genres qui possèdent l'état de caractère en question. Pour ce faire, nous prenons le rapport nombre de genres ayant tel état de caractère sur le nombre de genres pour lesquels nous possédons le renseignement désiré, multiplié par 100. Nous avons dû procéder ainsi, car il n'y a pas toujours de renseignements pour tous les genres dans une famille donnée. Lorsque l'état de caractère est connu pour la famille en général, nous mettons automatiquement une fréquence de 100.

Les données furent traitées selon les méthodes d'analyse multifactorielle suivantes: analyse en composantes principales (PCA centré et standardisé) et analyse des correspondances (RA)[5] en utilisant le programme ORDIFLEX[6].

Résultat et discussion. L'analyse de la représentation graphique de chacune de nos ordinations nous a permis d'effectuer certains rapprochements entre les familles de la sous-classe des Hamamelididae. Les 2 méthodes utilisées (RA, PCA) donnent sensiblement le même patron d'agencement des différentes familles et on peut y déceler 5 groupements principaux (figures 1 et 2). A l'extrême gauche, les Trochodendraceae, les Tetracentraceae et les Cercidiphyllaceae sont rassemblés pour former un groupe considéré par la plupart des auteurs comme primitif et intermédiaire entre les Magnoliales et les Hamamelidales[4, 7]. Notons que Cronquist[7] inclut les Cercidiphyllaceae dans les Hamamelidales.

Le 2e groupe (Eupteleaceae, Didymelaceae, Hamamelidaceae, Platanaceae, Myrothamnaceae et Balanopaceae) correspond aux ordres des Eupteleales, des Didymelales, des Hamamelidales et des Balanopales. Cette disposition appuie l'idée selon laquelle les Hamamelidales relieraient les Trochodendrales aux ordres des Amentifères (Casuarinales, Urticales, Bétulales, Fagales, etc.)[2]. Il est intéressant de noter que les 2 ordinations isolent les Amentifères des ordres plus primitifs des Hamamelididae tels que les Hamamelidales, les Trochodendrales et les Cercidiphyl-