**Results**

The values for mean number of eggs per pot, the variance / mean ratio, the value of *k* for the distribution of eggs, the proportion of patches containing eggs and the hatch-rate of the eggs showed no difference between mixed species cultures compared to those in the appropriate single species culture (Table 1; $P > 0.05$, ANOVA and Mann-Whitney tests). This indicates there was no effect of either species on the egg laying behaviour of the other.

Table 1. Summary of egg laying performance in single and mixed species cultures (mean ± SE; N = 4)

| | *D. mel* | *D. mel* mixed | *D. hydei* | *D. hydei* mixed |
|---|---|---|---|---|
| Eggs per pot | 15.9 ± 3.3 | 19.4 ± 5.3 | 14.8 ± 5.4 | 24.2 ± 8.6 |
| variance / mean | 24.1 ± 8.4 | 20.9 ± 7.7 | 41.1 ± 4.1 | 42.7 ± 15.5 |
| *k* of egg distribution | 0.573 ± 0.047 | 0.673 ± 0.223 | 0.137 ± 0.054 | 0.239 ± 0.141 |
| Occupied patches (%) | 79.7 ± 1.3 | 75.0 ± 10.9 | 37.5 ± 9.2 | 45.8 ± 15.8 |
| Egg hatch rate (%) | 57.55 ± 5.82 | 58.53 ± 5.25 | 33.63 ± 9.44 | 39.70 ± 10.60 |

To assess whether there was any association between the species in mixed cultures, $\chi^2$ tests were used to examine the presence or absence of eggs within each patch (Table 2). No significant negative or positive associations between the eggs of the two species were found.

Table 2. Association of *D. hydei* and *D. melanogaster* eggs in mixed culture cages.

| | Number of patches with eggs of: | | | | | |
|---|---|---|---|---|---|---|
| | *D. mel* only | *D. hyd* only | Both species | Neither species | $\chi$ 2 | P |
| Replicate 1 | 19 | 1 | 2 | 26 | 0.682 | >0.30 |
| Replicate 2 | 18 | 4 | 19 | 7 | 0.762 | >0.30 |
| Replicate 3 | 21 | 2 | 21 | 4 | 0.584 | >0.30 |
| Replicate 4 | 8 | 3 | 36 | 1 | 0.180 | >0.50 |

**Discussion**

Although the larvae of these two species interact in various ways and with varying intensity when restricted to smaller, less complex, laboratory environments, in this experiment the adults did not modify any of the parameters measured in the other species' performance. Even at these artificially high densities of adults flies, the pattern of egg laying of one species was not affected by the presence of the other. The eggs of both species tended to be highly aggregated and showed no association with those of the other species. These results agree with similar studies investigating the distribution and independence of egg laying in *Drosophila* (Rosewell *et al.*, 1990; Shorrocks *et al.*, 1990; but see Worthen and McGuire, 1988).

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## Is *Zaprionus indianus* Gupta, 1970 (Diptera, Drosophilidae) currently colonizing the Neotropical region?

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On March, 20th, 1999, while walking in an orchard belonging to a ranch named *Chácara Santa Mônica*, which stands 11 km NE of Santa Isabel, in the metropolitan area of São Paulo City, state of São Paulo, Brazil, I spotted some overripe and partially eaten persimmon fruits still attached to a persimmon tree (*Diospyrus kaki* L.; Ebenaceae). Inside a large hole of one fruit, about half of its diameter and probably made by birds, I noticed, among some large beetles and wasps, several small flies moving their probosces back and forth very rapidly, apparently devouring the wet pulp. Two or three of these flies especially attracted my attention for they had a pair of white and conspicuous stripes along the submedian area of the dorsal surface of the head and thorax, an unnusual feature for the neotropic drosophilids. Immediately, I remembered that only

in the museum's collections I had seen similar specimens, which I supposed, at first sight, to belong to a species of the genus *Zaprionus*, described in 1902 (cited in several papers as 1901) by Coquillett. Unfortunately, I had no vials and entomological net, so I was unable to capture the flies.

One week later, on March 27th, early in the morning, I returned to the same place with the collecting kit. However, there were no fruits of a similar stage of ripening at a workable height. Therefore, I looked on the ground for the remains of some still wet, fallen persimmon fruits and I could see, among several drosophilids, some white-striped flies, apparently feeding and also performing courtship movements.

Among one hundred and sixty-eight drosophilids aspirated (Table 1) on three fragmented fruits, from 10 to 11 a.m., I identified sixty-six (forty-five males and twenty-one females) specimens as belonging to *Zaprionus indianus* Gupta, 1970, a species of Afrotropical origin, which is currently widespread in three other biogeographical regions. One male of the latter flies was dissected and its terminalia compared with the drawings presented by Tsacas (1980) for the five African sibling species belonging to the *Z. vittiger* complex, which was later diagnosed and renamed as *Z. vittiger* subgroup (currently comprising 12 species) by Chassagnard and Tsacas (1993). Complex nomenclatural problems involving the several binomials under which this widespread biological species, currently recognized as *Zaprionus indianus*, has been identified were the subject of a paper by Tsacas (1985). The genus *Zaprionus*, which currently comprises 52 described species (Chassagnard and Kraaijeveld, 1991; Chassagnard and Tsacas, 1993) inhabiting the Australian, Afrotropical, Oriental and Palearctic regions, and the species *Zaprionus indianus* are recorded for the first time from the American continent. In an attempt to produce isofemale lines, twenty out of the 21 aspirated females were kept, each with a male, individually in vials with banana-agar medium, under controlled temperature (22 ± 1°C), and all of them yielded offspring. After the third day, the larvae were given, once a day, fresh Baker's yeast and *ca.* 18 days later the imagines of the first generation emerged in large numbers.

To check if the flies were also using persimmon fruits as breeding sites, fragments of five wet fallen fruits were also collected on March, 27th, and kept individually in ¼ liter vials containing a layer of wet sand, under controlled temperature (22 ± 1°C) and photoperiod (13 h : 11 h; L : D). The emerged flies were daily aspirated and are also listed in Table 1. A total of 399 imagines emerged, of which 44.1 % belong to *Zaprionus indianus* and 45.1% to *Drosophila malerkotliana*. It should be pointed out that both drosophilid species are introduced to the neotropics and together they represented most (89.2%) of the flies that emerged from the fruits of persimmon tree, also an introduced species. Voucher specimens of the isofemale lines and of both aspirated and emerged flies will be housed in the *Museu de Zoologia, Universidade de São Paulo,* São Paulo City, Brazil.

As far as I know, no strain of any species belonging to the genus *Zaprionus* has ever been maintained, either in the *Laboratório de drosofilídeos, Departamento de Biologia, Universidade de São Paulo*, São Paulo City, since its establishment in 1943 under the leadership of Prof. Th. Dobzhansky, or in any of the several laboratories dedicated to the study of drosophilids that had been set up subsequently in other cities of the state of São Paulo and in other states of Brazil. The collections made since 1943 in several localities of the country apparently have never sampled any specimen of any species belonging to the genus *Zaprionus*. This fact seems to indicate that this afrotropical species has very recently been introduced in Brazil. Whether or not it will be able to spread its distribution through the several ecosystems of the American continent in competition with the local species is unpredictable.

It should be pointed out that strains of many species of *Zaprionus* had been maintained for decades in the *Drosophila* Species Resource Center at Austin, Texas, USA, which is currently at Bowling Green, Ohio. So, there is a remote possibility that specimens could have escaped from the laboratory in Austin, reached the wild, spread southwards through Mexico and Central America and finally reached South America. If this was the case, the species would likely have been collected somewhere on its route southwards.

Another hypothesis is that it could have been introduced into the state of São Paulo, directly from some area out of the three biogeographical regions where it currently is a common species. As the surveyed orchard and the International Airport of São Paulo at Guarulhos stand, in straight line, only *ca.* 33 km apart from each other, there is a great possibility that the flies could inadvertently have been introduced by means of airplanes, either as adults, due to the increasingly number of flights from several African and Asian countries to São Paulo City, or as larvae and/or eggs eventually present in meals (fruits for instance) offered to

passengers. If this was the case, the African *Zaprionus indianus* could currently be gradually spreading its geographical distribution, in the Brazilian territory, from the putative area of introduction.

Table 1. Imagines of drosophilids aspirated from overripe, fallen persimmon fruits, on March 27th, 1999 at *Chácara Santa Mônica*, 11 km NE of Santa Isabel, state of São Paulo, Brazil or emerged from the remains of five of them collected on the same day on the ground and brought to the laboratory

| Species | aspirated | | emerged | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| *Drosophila bandeirantorum* | 1 | 0 | 0 | 0 |
| *Drosophila caponei* | 0 | 2 | 0 | 0 |
| *Drosophila capricorni* | 1 | 0 | 0 | 0 |
| *Drosophila malerkotliana* | 15 | 8 | 90 | 90 |
| *Drosophila medioimpressa ?* | 0 | 2 | 0 | 0 |
| *Drosophila pallidipennis* | 1 | 1 | 1 | 0 |
| *Drosophila paulistorum* | 4 | 3 | 0 | 0 |
| *Drosophila polymorpha* | 1 | 1 | 1 | 1 |
| *Drosophila simulans* | 1 | 1 | 11 | 11 |
| *Drosophila sturtevanti* | 5 | 2 | 0 | 0 |
| *Drosophila willistoni* | 28 | 25 | 10 | 7 |
| *Drosophila zottii* | 0 | 0 | 0 | 1 |
| *Zaprionus indianus* | 45 | 21 | 82 | 94 |
| TOTAL | 102 | 66 | 195 | 204 |

It should be pointed out that on April, 10th I noticed, at the same surveyed ranch cited above, several white-striped imagines (not collected) probably belonging to *Z. indianus* feeding on a perforated overripe orange fruit, which was still attached to an orange tree (*Citrus sinensis* (L.) Osbeck; Rutaceae), thus indicating that the introduced flies are not exclusively associated to the persimmon fruits in that area. It's worthwhile to note that Lachaise and Tsacas (1984) reported 73 kinds of fruits belonging to 31 families of plants, both native and introduced to Africa, as breeding sites for the fruit breeder *Z. indianus*.

According to Tsacas (1985) and Chassagnard and Kraaijeveld (1991), *Zaprionus indianus* is an invading fly of Afrotropical origin, where it is the most common species of its genus, and is currently widespread in India and several islands of the Indian Ocean. It should be pointed out that it was also reported to occur in the Atlantic Saint Helena Island, which stands midway between Africa and meridional South America. Therefore, this island could also have been a step in its movements, probably mediated by humans beings, from one or several African countries to Brazil.

Being a invading and generalist species regarding its breeding sites (Chassagnard and Kraaijeveld, 1991), it is likely that given opportunities it could become, very rapidly, a semicosmopolitan species widespread in the tropical zone of the world. The monitoring of its route in the Neotropical region, including the Caribbean islands, and even in the southern Nearctic region is desirable. It would also be interesting to check if it will be able to breed in native and not commercialized neotropical fruits and to analyze the results of its likely competition with the local species.

Acknowledgments: I would like to thank Dr. Ann J. Stocker for her comments on the manuscript. I am also indebted to FAPESP, CAPES, CNPq and FINEP (66.93.0618.00) for financial support.

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