LIFE HISTORY ESTIVATIVES IN TWO GEOGRAPHIC STRAINS OF *Zaprionus indianus* GUPTA, 1970 (DIPTERA: DROSOPHILIDAE)

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ABSTRACT: Two geographic strains of *Zaprionus indianus* collected from two distinct Brazilian Southeast regions of different environmental conditions were compared in relation to their life history estimatives. The Jaboticabal strain laid almost double the amount of eggs than the Valinhos strain. However, the Valinhos strain showed a higher viability rate. The number of eggs distributed during the female life span allowed for the characterization of three oviposition periods. The flies from Jaboticabal laid 32% of their eggs in the initial and terminal periods, while the Valinhos strain laid only 11% during these periods. The remainder of the eggs was distributed during the middle production period. The Jaboticabal strain tended to show larger longevity and fertility (egg productivity) values, whereas the adult productivity for the Valinhos eggs was greater. Based on the analyzed facts, the success of the colonization by South American invader *Z. indianus* seems to be closely related to the capacity and velocity of changes in the time length of total longevity (TL) or in the life span of the species, in regards to the different favorable and unfavorable conditions found in the invaded habitats. These potential variabilities, allied with different selective pressures such as competition, may have provided this species success in adapting to the new environments found in the colonization of the Americas.

Keywords: Emergence; invasive species; longevity; viability

ESTIMATIVAS DA HISTÓRIA DA VIDA EM DUAS LINHAGENS GEOGRÁFICAS DE *Zaprionus indianus* GUPTA, 1970 (DIPTERA: DROSOPHILIDAE)

RESUMO: Duas linhagens geográficas de *Zaprionus indianus* capturadas em duas regiões geográficas do suldoeste brasileiro, com diferentes condições ambientais foram comparadas em relação às estimativas da história de suas vidas. A linhagem de Jaboticabal colocou quase o dobro da quantidade de ovos que a linhagem de Valinhos. Contudo, a linhagem de Valinhos mostrou uma alta taxa de viabilidade. O número de ovos postos e distribuídos durante a vida das fêmeas, permitiu a caracterização de três períodos de oviposição. As moscas da linhagem de Jaboticabal colocaram 32% de seus ovos nos períodos inicial e terminal, enquanto a linhagem de Valinhos colocou somente 11% durante estes períodos. O restante dos ovos foi distribuído durante o período médio de produção. A tendência da linhagem de Jaboticabal foi de mostrar grandes valores para a longevidade e fertilidade (produção de ovos), enquanto a produtividade de adultos, a partir dos ovos da linhagem de Valinhos foi maior. Baseado nos fatos analisados, o sucesso da colonização da América do Sul pelo invasor *Z. indianus* parece estar relacionado com a capacidade e velocidade de mudanças no comprimento do tempo da longevidade total ou no tempo do ciclo de vida da espécie, em relação às diferentes condições favoráveis ou desfavoráveis encontradas nos diferentes habitats invadidos. Estas potencialidades de variação aliadas às diferentes pressões seletivas como a competição, podem ter conferido à espécie sucesso na adaptação para os novos ambientes encontrados na colonização das Américas..

Palavras-chave: Emergência; espécie invasora; longevidade; viabilidade

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INTRODUCTION

The *Zaprionus* Coquillett, 1901, genus is constituted of 57 species (Chassagnard & Kraaijeveld, 1991; Chassagnard & Tsacas, 1993), where *Z. indianus* is considered the most common fly of the African continent (Lachaise & Tsacas, 1983). This species was first described by Gupta (1970) using flies captured in India. Being an opportunistic organism, they attack an extensive variety of substrata that is found in all tropical regions of Africa, Asia (Gupta, 1970; Shakoori & Butt, 1979; Chassagnard & Kraaijeveld, 1991; Chassagnard & Tsacas, 1993) and South America (Vilela, 1999; Stein *et al*., 1999; Castro & Valente, 2001; Goñi *et al*., 2001, 2002; Tidon *et al*., 2003; Pires & Bélo, 2005).

The presence of *Z. indianus* was recorded in Brazil for the first time in the district of Santa Isabel (SP), by Vilela *et al*., (2000), in persimmon fruit (*Diospyros kaki*, L.). In Valinhos orchards, where is a plague to *Ficus carica*, L., 90% of the flies that visit the syconium are *Z. indianus* ovipositing females (Pires & Bélo, 2005).

Records show that this species is already all over Brazil. This was observed in the islands near the shores of the State of Santa Catarina (Toni *et al*., 2001), in *Aleurites mollucana* Willdenow, 1797, and *Arecastrum romanzoffianum* Becc.,1916, baits. In the city of Porto Alegre (RS), Silva *et al*., (2005) verified that there was an abundant amount of *Z. indianus* during hot periods. Before its appearance, *Drosophila simulans* Sturtevant, 1919, had always been the most common species in this city. According to Castro & Valente (2001), unlike the other species of *Drosophila* Fállen (Diptera: Drosophilidae), *Z. indianus* females lay their eggs in unripe fruit, causing damage to the pomology.

Santos *et al*., (2003) found the species in the northeast region of Brazil in the State of Bahia, in the San Francisco river basin, inside *Spondias tuberose* Arruda, fruits. Along the coast of State of Pernambuco, it was found colonizing fruits of *Jambosa vulgaris* Adans, 1826, *Spondias purpurea* L. and *Genipa Americana* L.; in the Cerrado biome (Oliveira & Marquis, 2002) of central Brazil (Tidon *et al*., 2003; Leão & Tidon, 2004), and in environments with different degree of urbanization (Ferreira & Tidon, 2005). In the southern regions of Uruguay, its presence was shown by Goñi *et al*., (2001, 2002), while exploring native and introduced fruits. Recently, Linde *et al*., (2006) described its occurence in Central America (Panama) and North America (Florida).

In the State of São Paulo of the Brazil Federal Republic this species is common in fruit orchards (Pires & Bélo, 2005), where it has always been found struggling for hegemony with *D. simulans*. This suggests that these species could be competing to each other to explore the available resources. The results of the present study are viewed as contributions for the better understanding of the problems raised by the biological and economical losses surrounding this invading species. The recognition of the characteristics responsible for the successful invasion and the understanding of its processes may help the comprehension of the known facts and subsequently the development of strategies to minimize the impacts of invasive species, where *Z. indianus* represents an excellent model for the study of biological invasions.

The objectives of this research are to use estimatives such as developmental time egg-pupa, adult longevity, total longevity, oviposition, emergence, viability and others, to obtain information about biological aspects of *Z. indianus* searching for explanations about its successful colonization into the new environments found in the Americas.

MATERIALS AND METHODS

The *Z. indianus* strains used in this research are from two populations, of two regions within the State of São Paulo, each having distinct ecological characteristics. The Jaboticabal region (latitude 21º15’17’’S, longevidade 48º19’20’’W, altitude 605 m) has a mean annual temperature of 25ºC, with sugar-cane culture being predominant. In the Valinhos region (latitude 22º58’14’’S, longitude 46º59’45’’W, altitude 660 m), 240 km away, there are milder temperatures with a mean annual temperature of 22ºC, where pomology is predominant. According to the Köppen classification the Jaboticabal climate type is Aw (Anonymus, 2009) and Valinhos is Cwa (Anonymus, 2009a). Valinhos is located 78 km from Santa Isabel (SP), where Vilela (1999) first detected the presence of the species in South America. For both strains, all laboratory stock flies were started with 50 couples. The founders of the Valinhos strain were collected on 06/14/02 and the founders of the Jaboticabal strains on 08/09/02.

Five recently emerged couples from stock, were distributed in nine test tubes (3,5 cm x 28 cm).Thus, all estimatives applied to analyze the biological features of *Z. indianus* were obtained directly or indirectly from these 90 flies (45 males and 45 females) per strain (parental flies). On a daily basis, a new small plastic spoon was placed inside each test tube with 3 ml of medium (water 1000ml, wheat flour 80g, corn flour 80g, arrowroot flour 10g, gelatin 12g, yeast 8g, agar 4g, 10% of nipagin alcoholic solution 8ml, and propionic acid 2ml) for feeding and ovipositing. The number of eggs (F_1) per strain on all nine spoons was counted daily until the last day of the flies’ life (parental flies).

All of the tests were conducted in a chamber with temperatures of 25 ± 2ºC, 70-75% humidity rate, and photoperiods of 12 hours. To avoid the Pearl & Parker (1922) information about the density effects on the populations, the eggs (F_1) were placed into test tubes daily (when the number of eggs was equal or less than 10) and/or ¼ litter jars (when the number of eggs was greater than 10 and less than 40, number of ¼ litter jars were used as needed) with medium to prevent competition among larvae until larvae grew into adults (F_1 flies).

The measure of the ovipositing time (*OT*) was done by a pondered mean with the following formula:

$$OT = \frac{\sum_{i=1}^{nd} d_i O_i}{\sum_{i=1}^{nd} O_i}$$

where d_i is the *i-th* number of days ovipositing by the parental flies and O_i is the mean of eggs by females on *i* day.

The longevity of the 90 adult flies (*AL*) was evaluated from the emergence until death (parental flies). The analysis was done counting the dead flies daily, which were subsequently removed from the test tube, until the last fly died.

In this study, the term total longevity (*TL*) refers to the fly life-span from egg to death as an adult fly. In this sense, the adult longevity (*AL*) of parental flies obtained from stock was measured and analyzed, whereas the developmental time egg-pupa (*DTEP*) was measured from F_1 eggs laid by parental flies until the pupa phase end. Thus, total longevity (*TL*) is the sum of developmental time egg-pupa (*DTEP*) and adult longevity (*AL*).

The value attributed to developmental time egg-pupa (*DTEP*) was based on the number of F_1 flies gender emergence. Therefore, due to daily observation of the test tubes and ¼ litter jars control, it was possible to determine the time it took for each individual by gender and strain to develop from egg to pupa, here considered end of period one day before emergence of each fly according to gender.

Data regarding developmental time egg-pupa (*DTEP*) were gathered following an order of distribution from the lower value to the greater values. The frequencies of each value or “class” shown by the offspring (F_1) were distributed according to percentages of the total. In order to obtain total longevity (*TL*), the developmental time egg-pupa (*DTEP*) values were distributed from 45 (individuals) for each gender (following the previus distribuition) to be add up to values obtained for adult longevity (*AL*) for each gender of the parental flies.

Thus, the values for males and females from Jaboticabal and Valinhos in order to calculate the developmental time egg-pupa (F_1 individuals), adult longevity (parental flies) and total longevity (*TL*) were obtained through a pondered mean, as follow:

$$L = \frac{\sum_{i=1}^{nd} d_i n_i}{N}$$

where N is 45 and n_i represents the number of individuals on *i-th* day and d_i represents the life span.

The average emerging time of the flies (*ET*) was calculated using the following pondered mean:

$$ET = \frac{\sum_{i=1}^{nd} d_i E_i}{\sum_{i=1}^{nd} E_i}$$

where d_i represents the *i-th* day of emergence, from the placing of the progenitor imagoes into the test tubes; meaning from the beginning of the experiment. E_i represents the *i* number of emerged individuals.

In the present study viability was obtained by the summation of emerged individuals (F_1) divided by the number of eggs laid (F_1) by parental females, for each day of observation, where the total is multiplied by 100 and divided by the number of observation days.

The mean eggs per female (*EF*) and the mean emergence per female (*EGF*), were obtained similarly. For instance, in regards to the mean eggs per female (*EF*) indicator, initially the summation of eggs (F_1) divided by the number of living females (parental) for each day of observation was obtained, and the result was subsequently divided by the total number of observation days for the period.

To detect the existence of differences between males and females per strain regarding developmental time egg-pupa (*DTEP*), adult longevity (*AL*), and total longevity (*TL*), a variance analysis was performed (both genders and both strains). For the significant differences among means, the Tukey test (5%) was used.

In order to discern between values obtained for oviposit time (*OT*), emergence time (*ET*), mean eggs per female (*EF*) and values obtained for mean emergence per female (*EGF*), between the two strains, the Student's t-test was applied.

The differences in numbers of flies produced in the emergence of imagoes were compared as to gender, using chi-square test (χ^2) to verify if the female x male numbers deviated from expected 1:1 proportion.

RESULTS

The Jaboticabal strain (parental flies) showed a greater longevity than Valinhos strain (Figure 1 and 2) and the males of both strains showed greater longevity than the females. It is possible, at first glance, to conclude based on these finding that males and females of the Valinhos strains had a shorter life span than the males and females from the Jaboticabal strain. The last Jaboticabal female lived alone 24 days, while the last Valinhos female lived alone 15 days. The last males of both strains did not have such long life spans.

The Jaboticabal strain females (Figure 3) started produce eggs at four days old and this ovipositing period lasted for 56 days, while the Valinhos strain (Figure 4) began ovipositioning on the same day of emergence, this period lasted for only 46 days. The distribution dynamics of the eggs permitted for a characterization of three periods: the initial ovipositing period, the middle production period (between the 13th and 38th day in the Jaboticabal strain; and the 12th and 37th day in the Valinhos strain) and the terminal ovipositing period. During the middle production period, the number of eggs of the Jaboticabal strain varied between 168 to 273 eggs, while in the Valinhos strain the variation was between 67 and 233 eggs.

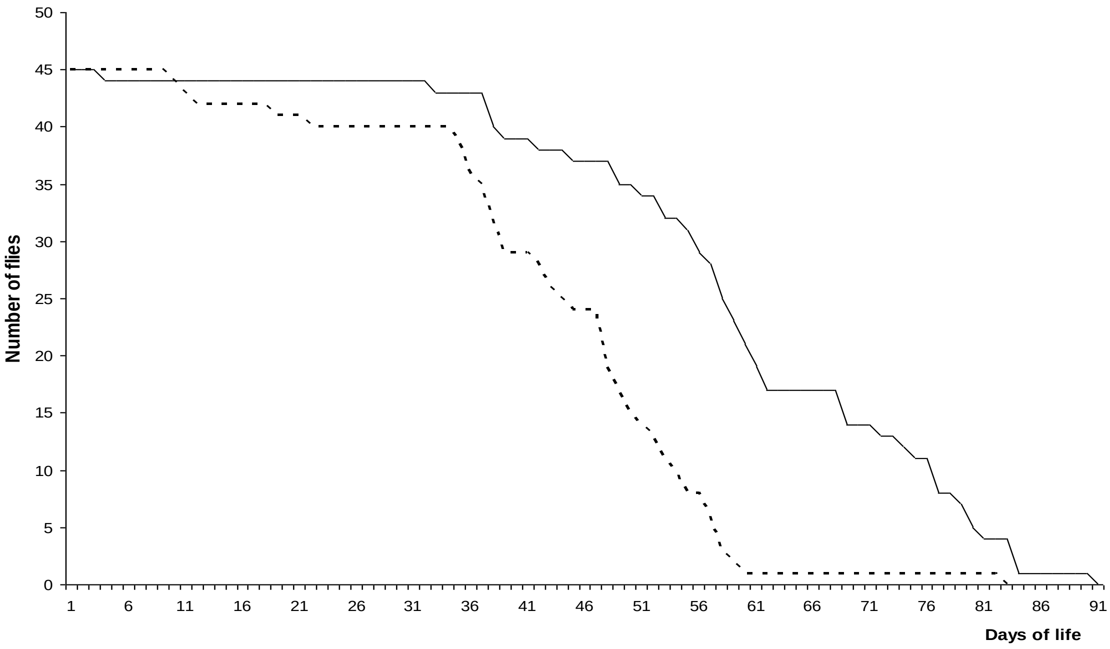

FIGURE 1- ***Zaprionus indianus*** **longevity, males (———) and females (---------) of the Jaboticabal strain.**

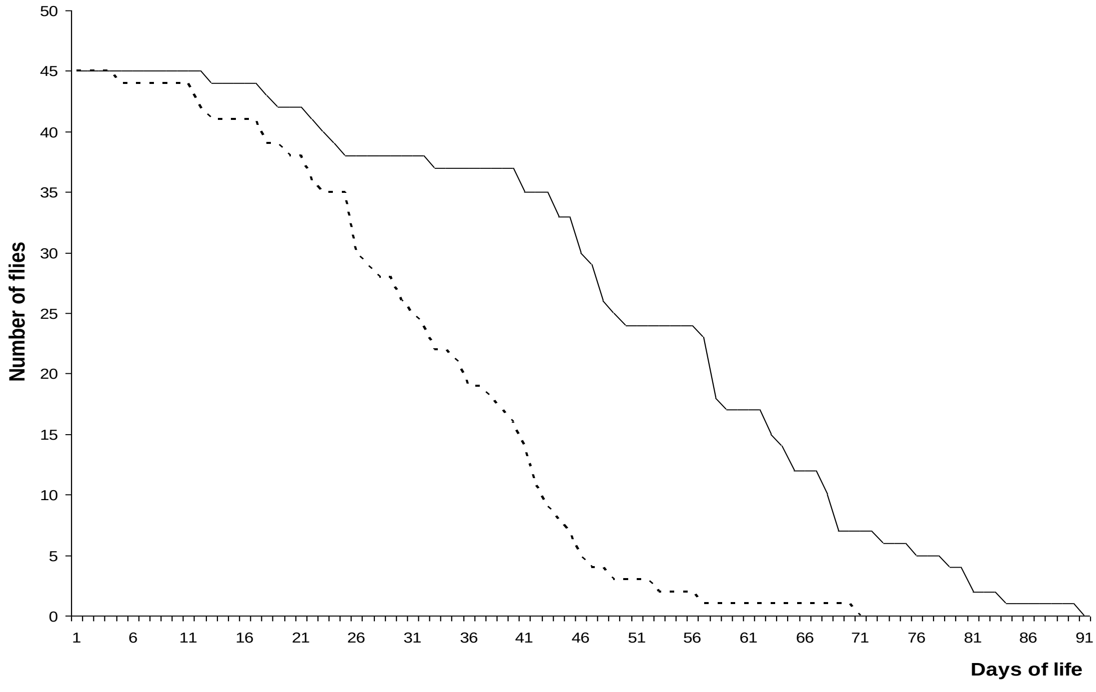

FIGURE 2- ***Zaprionus indianus*** **longevity, males (———) and females (----------) of the Valinhos strain.**

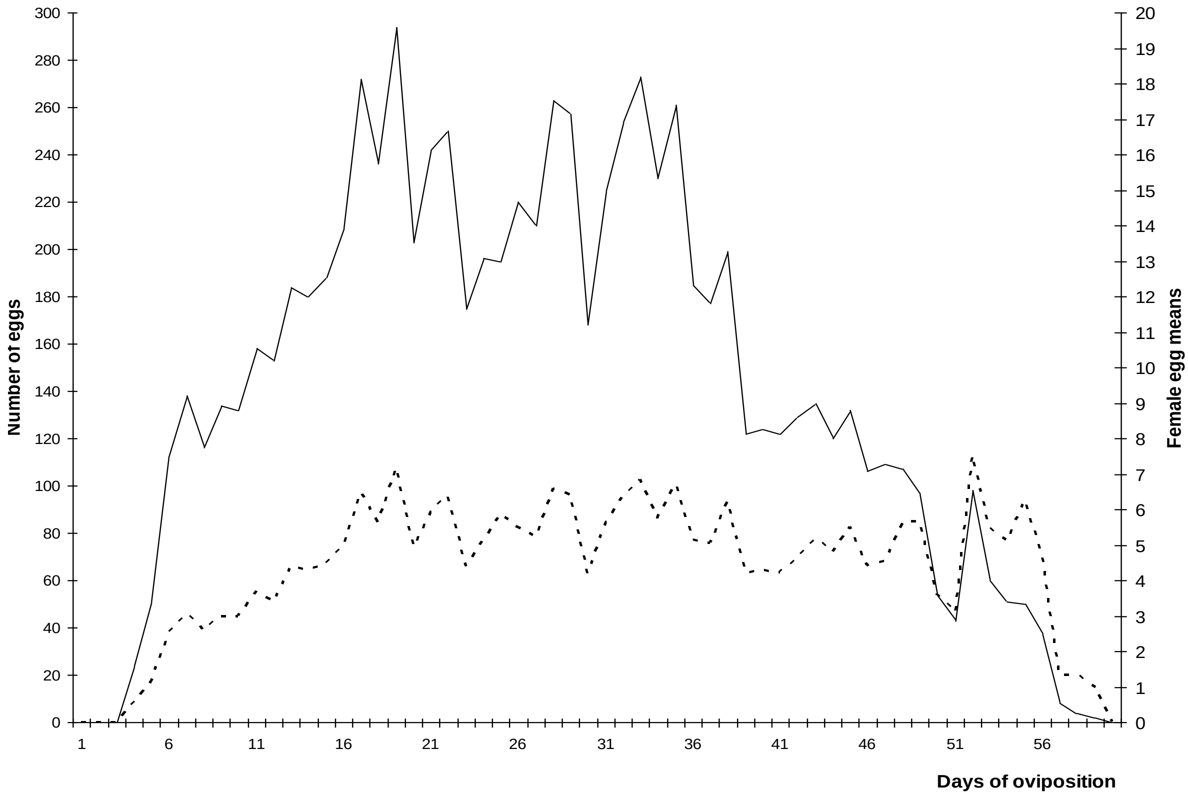

FIGURE 3- Numbers of oviposited eggs (———) and mean female eggs (---------), during the life of *Zaprions indianus* for the Jaboticabal strain.

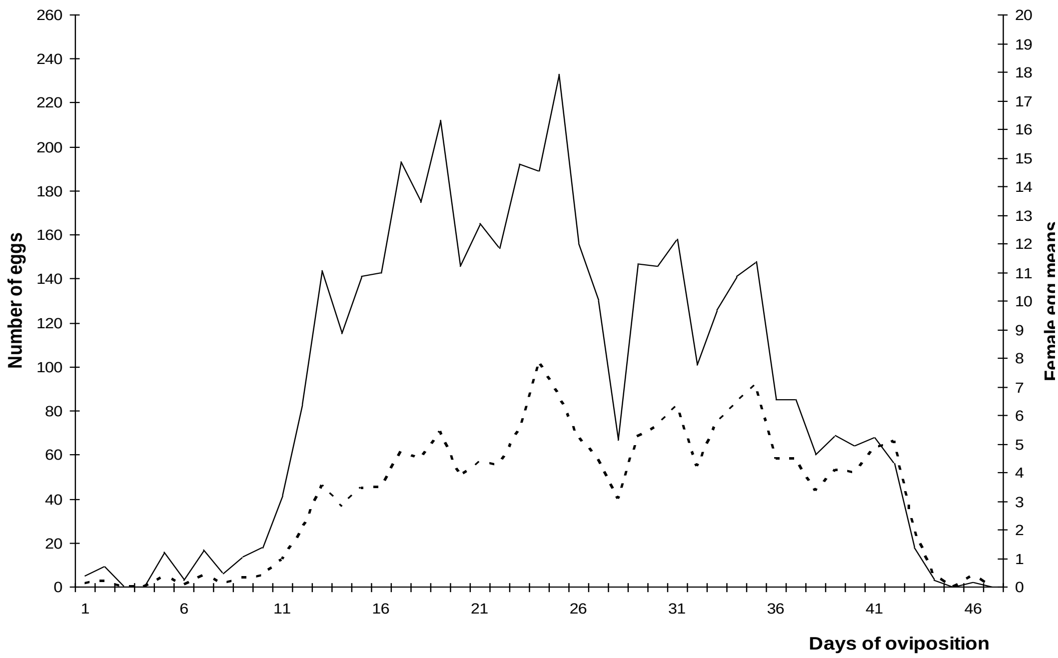

FIGURE 4- Numbers of oviposited eggs (———) and mean female eggs (---------), during the life of *Zaprionus indianus*, for the Valinhos strain.

Considering the female egg means, the Jaboticabal strain presented a production growth until the 17th day of the female life, following oscillations in numbers until the 55th day. After this period there was a sharp decrease in production and on the 59th day the last two eggs were laid.

The Valinhos strain presented a longer period to increase the average production of eggs per female (19 days) with an increase lower than the Jaboticabal strain. The middle production period per female from the Jaboticabal strain (38 days) was larger than the same period in the Valinhos strain (23 days). The average oviposit time (*OT*) per female for Jaboticabal was 32.33 ± 11.19 days, and 27.69 ± 10.81 days for Valinhos (t= 0.29; P>0.05).

The total number of eggs oviposited by the Jaboticabal strain was 8,463, almost double the eggs presented by the Valinhos strain, 4,250 (Table 1). The percentages of eggs laid in the initial and terminal periods were lower than the number of eggs oviposited during the middle production period. These differences were significantly more pronounced in the Valinhos strain, where the initial and terminal production periods presented the lowest percentage of oviposited eggs. The females from Jaboticabal laid 32% of their eggs during the first and the last periods. In the middle production period, the females from Valinhos were more productive, laying 89% of its eggs, whereas 68% of the eggs for the Jaboticabal strain were laid in the same period. The initial and terminal production periods for both strains had less days of oviposition, and this number was significantly lower for the Valinhos strain during the terminal period.

The developmental time egg-pupa (*DTEP*) mean (Table 2) did not differ between males and females from the same strain, but significanty differences

TABLE 1 – Number of eggs produced, number of days of oviposition and percentages of eggs produced by females of both *Z.indianus* strain, in the three oviposition periodis.

Laying	Number of days of oviposition		Number of eggs		Eggs percentages	
	Jaboticabal	Valinhos	Jaboticabal	Valinhos	Jaboticabal	Valinhos
Initial period	12	11	1008	130	11.91	3.06
Middle production period	26	26	5746	3775	67.90	88.93
Terminal period	21	09	1709	340	20.19	8.01
Total	59	46	8463	4245	100.00	100.00

TABLE 2- Mean and standard deviations to estimatives of the longevity types in different phases of *Z. indianus* life.

Strains	Developmental time egg – pupa (*DTEP*)		Adult Longevity (*AL*)		Total Longevity (*TL*)	
	Males	Females	Males	Females	Males	Females
Jaboticabal	17.95 ± 0.36 b	18.07 ± 0.35 b	60.80 ± 2.53 c	44.51 ± 2.08 b	78.76 ± 2.60 c	62.58 ± 2.10 b
Valinhos	12.36 ± 0.26 a	12.24 ± 0.31 a	53.51 ± 2.85 c	33.53 ± 1.95 a	65.87 ± 2.84 b	45.78 ± 1.92 a
$F_{3;176}$	102.14^{***} (SMD= 1.19)		24.35^{***} (SMD= 8.75)		32.01^{***} (SMD= 8.80)	

Means followed by equal letters, inside of each phase of the flies life are equal.
MSD = Minimum significant difference of the Tukey test.
*** = Significant at level 0.1%.

were detectable between strains, with Valinhos flies showing a shorter time than the Jaboticabal flies. The adult females showed a shorter longevity (*AL*) than the males in both strains, but Valinhos males (*AL*) showed a mean of longevity statistically equal to that of the Jaboticabal males.

The total longevity (*TL*) confirmed that females have a shorter life span than the males in both strains. The Jaboticabal females showed life periods which did not differ from that of the Valinhos males, while the last strain females presented the smallest value for this estimative (Table 2). Consequently, the life span results of *TL* indicated that the time from egg to adult was greater in the Jaboticabal strain.

The mean of eggs per female (*EF*) and the mean emergence per female (*EGF*) (Table 3) indicate that in spide of female from the Valinhos strain producing less eggs than the females from the Jaboticabal strain (t= 8.56; P< 0.01), the mean of imagoes produced per female was the same in both strains (t= 1.49; P> 0.05).

The Jaboticabal strain emergence (Figure 5) started on the 24th day from the beginning of the experiment and ended on 80th day, covering a period of 65 days. The Valinhos strain emergence (Figure 6), began on the 13th day and finished on the 63rd day, giving an approximate period of 50 days. The dynamics of emergence, for both strain can also be characterized in three periods: the initial emergence period (24th to 31st day in the Jaboticabal strain and 13th to 26th day in the Valinhos strain),The middle emergence period (32nd to 46th day in the Jaboticabal strain and 27th to 50th day in the Valinhos strain), and the terminal emergence period (47th to 79th day in the Jaboticabal strain and 51st to 62nd day in the Valinhos strain).

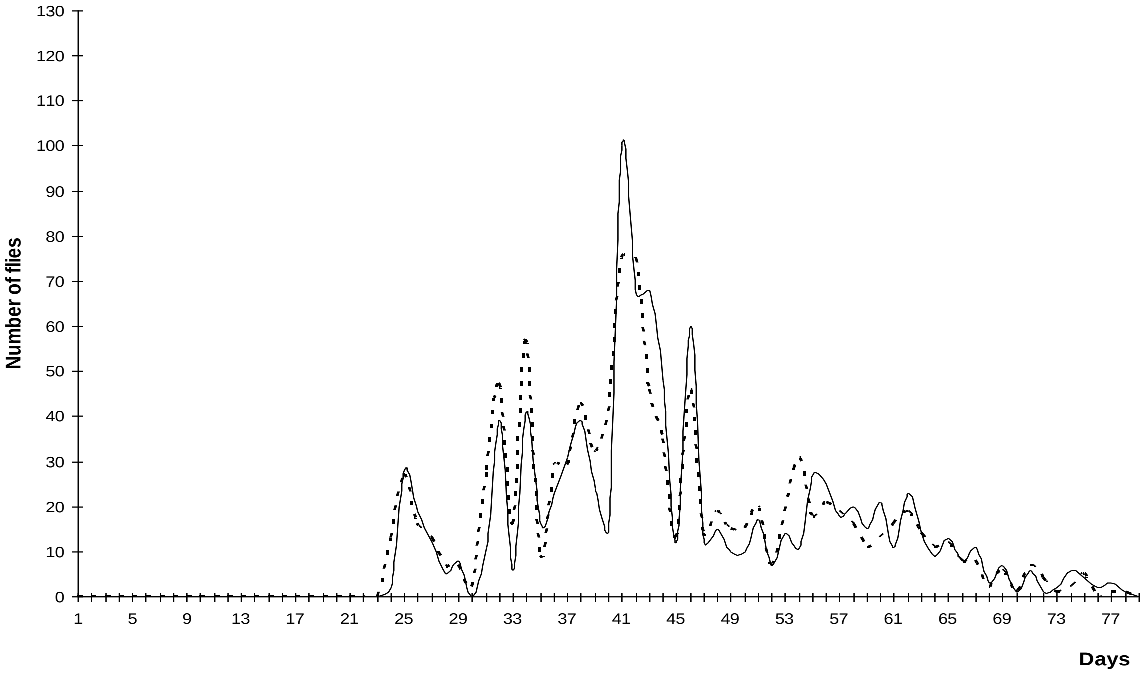

FIGURE 5- ***Zaprionus indianus*** **males (———) and females (----------) emergence for the Jaboticabal strain.**

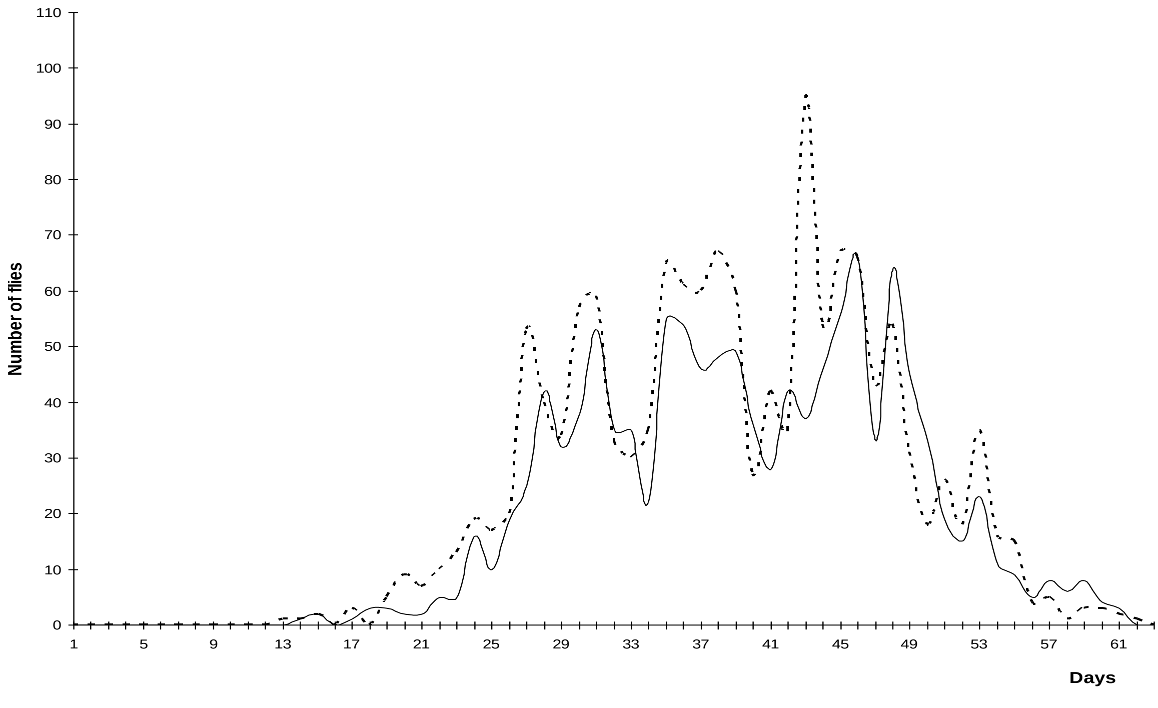

FIGURE 6- ***Zaprionus indianus*** **males (———) and females (----------) emergence for the Valinhos strain.**

TABLE 3- Egg and emergence mean per female of both ***Z. indianus*** **strains.**

Srains	Mean eggs per female (*EF*)	Mean emergence per female (*EGF*)
Jaboticabal	188.06 ± 3.18	46.28 ± 5.13
Valinhos	94.33 ± 10.35	58.33 ± 6.43
"t" Test	8.65***	1.49^{NS}

^{NS} = Not significant
***** = Significant at level 0,1%.**

On the 42nd day of emergence, the Jaboticabal flies presented the highest emergence peak of 100 males and 75 females. In the Valinhos strain, the highest female production (95) was on the 43rd day, and for males the highest production (66) happened on the 46th day. The Jaboticabal strain showed a mean emergence time of 44.73 ± 0.65 days and the Valinhos strain, 39.92 ± 1.22 days (t= 2.82; P<0.01).

In relation to the total amount of emerged individuals, the two strains showed a higher number of females (Table 4). The Valinhos strain showed no significant differences in the number of flies produced per sex, except for the terminal period. In every other case there were significant differences favorable to females. Independent of sex, the total emergence in the Valinhos was greater than that of the Jaboticabal strain due to an abundance of eggs produced during the middle production period. Regarding eggs from the other two periods, emergence was greater in the Jaboticabal strain.

The viability values showed to be substantially different, favoring the Valinhos strain (Table 4). The two strains presented superior values of viability in eggs oviposited during the middle production period and reduced viability in eggs oviposited during the initial and terminal periods. In relation to the middle production period, the viability value in the Jaboticabal strain was two times less than that of the Valinhos strain.

TABLE 4- Number and viability of emerged males and females of both *Z. indianus* strains in relation to the oviposition periods.

Laying	Emergence								Viability	
	Jaboticabal				Valinhos					
	Male	Female	χ^2	Total	Male	Female	χ^2	Total	Jaboticabal	Valinhos
Initial period	65	165	43.48***	230	28	47	4.82*	75	22.81	57.69
Middle production period	391	1198	409.84***	1589	1103	1288	14.32***	2391	27.65	63.33
Terminal period	92	172	24.24***	264	69	90	2.72^{NS}	159	15.44	46.76
Total	548	1535	467.68***	2083	1200	1425	19.28***	2625	24.61	61.83

^{NS} = Not significant
*= Significant at level 5%.
*** = Significant at level 0,1%.

DISCUSSION

The Jaboticabal strain presented a greater longevity (*TL*) than the flies from Valinhos strain, and the same was observed in males regarding the females. Imagoes which have a greater longevity (*AT*) can find more favorable places for living and for development of their offspring. It is possible that the differences in longevity are an adaptation strategy for living in different ecological conditions.

The adult longevity (*AL*) observed in this study was very close to that obtained by Stein *et al*. (2003) from 49 to 65 days for flies from Valinhos rised on a base diet consisting of banana and agar, whose results did not show differences between males and females, while Setta & Carareto (2005), using the same diet and flies of the same species, but captured in Mirassol, SP (about 450 km from Valinhos) obtained a mean longevity very different for males (68 days) and females (98 days). In the present study differences were also detected between sexes.

The evolutionary implication of females presenting lower longevity than males is an open question. A hypothesis could be that the oviposition being a expensive metabolic factor would result in lowered longevity (Itoyama & Bicudo, 1992). Similarly, Bressan & Teles (1991), verified that the male longevity for *Anastrepha bistrigata* Bezzi, 1919, was greater than that of the females, but the number of emerged females was greater than that of males. These sexual proportions favoring the emergence of females could contribute to an increase in population.

It is possible that the strains or species in adverse ecological conditions and having a greater longevity could be successful in the colonization of new ecological niches, where the flies could have the capacity to wait for favorable opportunities to develop. An opposite situation, favoring individuals with a shorter longevity, like in the Valinhos strain, could find favorable environments and quickly increase the population. Hence, they would have a higher survival probability in adverse conditions. Therefore, a greater number of individuals would be looking for favorable resources and have a greater probability to find them and perpetuate their offspring. According to Baldal *et al.* (2004) there is evidence that longevity and starvation resistence are determined by a common genetic mechanism.

The study of the oviposition rates in the three periods was helpful, and the estimatives analyzed showed the validity of them. The middle egg-production periods differed from the inicial and terminal ovipositing periods, and other differences observed in relation to the terminal period, which was longer in the Jaboticabal strain. The flies from Valinhos presented no pre-oviposition phase, while the flies from Jaboticabal started to oviposit at four days old. Thomazini & Berti Filho (2000) verified that the parasite, Pteromalidae, *Muscidifurax uniraptor* Kogan and Legner, 1970, which attacks *Musca domestica* L. pupa, also revealed no pre-ovipositing phase.

It is possible that the pre-oviposition phase could be useful for females to synthesize nutritive substances for reserve, which could be deposited in the ovule giving better conditions for embryo development. According to Houllin (1972) and Berkaloff *et al*. (1975), during the growth of the oocyte, organelles and yolk granules accumulate in the cytoplasm, and Boleli & Teles (1992) showed, in *Anastrepha oblique* Macquart, 1835 (which produces two types of eggs), that the smaller eggs were deposited during the initial stages of oviposition. In other insects (Murphy *et al*., 1983 and Moore & Singer, 1987) the variation of egg size was related to nutritional factors. Silva *et al*. (1991) showed that *Moscis latipes* Guenée, 1852, presented a decrease in the pre-ovipositing phase when treated in favorable nutritional conditions.

Contrarily to the oviposition in Jaboticabal strain which presented the largest production of eggs, Valinhos strain presented a larger number of emerged individuals. The two strains presented a fewer number of emerged imagoes from eggs laid in the initial and terminal periods. These strains however, did not present the same pattern of eggs distributions in all three periods, and those that were laid in the middle production period showed a greater viability, mainly in the Valinhos strain.

The estimatives concerning oviposition and emergence time could provide to populations of the same species, under different conditions, the opportunity to colonize a new environment. In relation to stochastic factors conditioned by the initial favorable or unfavorable environmental opportunities, these estimatives can offer different strategies for the organism.

Both strains differ in relation to oviposition and emergence, the Jaboticabal flies being more versatile than those from Valinhos as to the oviposition along the periods. Flies from Valinhos concentrated most of their eggs during the middle production period, presenting a greater viability and emergence rate than those from the Jaboticabal strain.

The number of imagoes produced reflected the age of the flies. Thus, in both strains, the eggs which were laid at the initial and terminal oviposition periods had lower values of emerged individuals than the eggs obtained during the middle production period. In both strains, the differences were more accentuated in relation to the eggs in the terminal oviposition period.

As well as the previously described estimatives, it was verified that flies from the Valinhos strain took less time to start oviposition, imagoes emergence and also presented the shortest emergence time (*ET*). However this strain produced the same number of individuals than the Jaboticabal strain. The data collected indicate that these strains have shown differences in relation to the analyzed estimatives that characterize them regarding the approached aspects. This indicates that the restrictions or concentrations in relation to time and production (eggs or imagoes), did not decrease the adaptative value of the Valinhos strain, and these results are presented as an alternative form of data in relation to the Jaboticabal strain.

In the natural environment there is probably competition between *Drosophila* and *Z. indianus*, mainly involving *D. simulans* because both are the most common species in fruit orchard collections (Pires & Bélo, 2005). However, the competition that Mayr (1977) showed is not a universal phenomenon and does not occur throughout all periods of the species life. The colonization in the Americas by *D. obscura* Aldrich, 1925, did not exclusively depend on their competitive capacity, but probably on their prolificness (Pascual *et al.*, 1998). Even though *Z. indianus* has a reasonable competitive capacity with the native species of *Drosophila* (Bélo, in preparation), the differences in the oviposition periods between strains are factors that should be considered in the fitness composition of this species.

It is evident that the genetic or behavioral characteristics which regulate oviposition and egg viability, and most characteristics accosted here, is not disbributed in an absolute or unique way within the populations of this species. There are great overlapping quantities of effects that do not phenotypically manifest, but only partially participate in the final phenotype. Therefore, once the changes in environmental characteristics take place, then each strain could change as well. Due to natural selection pressures, each strain could have the capacity to alter their characteristics in a few generations. These possibilities of variation, associated with other capacities such as competitiveness, could have given this invasive species a great adaptative skill in these different American ecological conditions.

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CONCLUSIONS

The Jaboticabal strain showed greater longevity (*TL*) than the flies from Valinhos, and the males from both strains also showed greater longevity (*TL*) than the females.

The females from Jaboticabal laid bigger number of eggs than the Valinhos females. Therefore, the adult emergence mean were egual to both strains. Based in the facts, was possible to divide the laid eggs period and the emergence period in three, which were shorter in the Valinhos strain than the Jaboticabal strain.

The differences in the life cycle duration between the strains, production of eggs, and emergence of flies were taken in concideration to reveal the importance of these estimatives in the adaptation to the Americas different environments, from that found in the origin region of the species.

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