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Studies on mosquitoes (Diptera: Culicidae) and anthropic environment. 5- Breeding of *Anopheles albitarsis* in flooded rice fields in South-Eastern Brazil*

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FORATTINI, O.P. et al. Studies on mosquitoes (Diptera: Culicidae) and anthropic environment. 5- Breeding of *Anopheles albitarsis* in flooded rice fields in South-Eastern Brazil. *Rev. Saúde Pública*, **28**: 329-31, 1994. Studies on breeding *Anopheles albitarsis* and association with rice growth in irrigated paddy fields were carried out during the rice cultivation cycle from December 1993 to March 1994. This period corresponded to the length of time of permanent paddy flooding. Breeding occurred in the early stage up until five weeks after transplantation when rice plant height was small. That inverse correlation may give potential direction to control measures.

Keywords. - Ecology, vectors. Anopheles. Mosquito control.

Introduction

It is well known that irrigation development results in an increased availability of water favoring mosquito breeding, mainly through habitat simplification and microclimate modification. As a result, relatively few species increase in prevalence after irrigation, compared with their levels in the natural environment. As a general pattern, that niche reduction may cause a decrease in species richness increasing the abundance of only those which found conditions suitable for exploitation (Amerasinghe & Ariyasena[1], 1990). However, some and even most of those that did become more abundant are potential vectors of human infections. In previous papers, data obtained demonstrating the relationship between the rice irrigation system in the south-eastern region of S.Paulo State, Brazil, and the emergence of some mosquito species were presented. Among these species *Anopheles albitarsis* has shown high immature stage production and, as a potential malaria vector, has deserved particular attention (Forattini et al.[3,4],1993). The present study was, thus, carried out to discover the pattern of that anopheline's breeding in relation to different stages of rice growth in the paddy fields. The results of these investigations are here presented.

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Material and Method

The study area and the rice cultivation cycle have already been described in the above-mentioned publications. Collections were made weekly during stages 3, 4 and 5 when artificial flooding was permanent and lasted three months, from 13 December 1993 until 14 March 1994. Immature specimen density was monitored using standard 500 ml dippers and was estimated as an average of the number of individuals collected per ten dips. Sampling was performed in two contiguous flooded paddies at the uniform rate of 180 dips per collection. Each paddy was sampled in alternate weeks that total number of dips being divided equally between the inner and the border areas for the purpose of verifying whether the insolation of the covering water sheet may influence larval breeding as that factor of change which varies according to the growth of the rice.

As mentioned above, stage 3, corresponding to rice transplantation, started in December 1993 and the permanent flooding on 13th of that month. The first collection was made on 20 December, but only at the paddies border so as not to damage the very young plants. These were nearly 15 cm in height, reaching 1.10m when stage 5 started, after which they grow no more and start to flower. Data about the climatic conditions during the period were obtained directly from the Climatology Section of the Campinas Agronomic Institute (Instituto Agronômico de Campinas) of S. Paulo State.

Results

A total of 610 *An. albitarsis* larvae were collected over thirteen successive weeks, seven of these being covered by stage 3 and three of than by each of stages 4 and 5 of the rice cultivation cycle. During that period, the atmospheric temperatures (oC) were recorded as follows:

month	maxim.	minim.	mean
December	30.3	20.5	25.4
January	29.3	20.1	24.7
February	33.9	22.2	28.0
March	29.4	20.1	24.8

The highest temperature recorded exceeded 38.0 oC and the lowest did not fall below 15.0 oC.

The weekly results obtained are presented in Table. It may be noted that larvae breeding occurred practically only during the first flooding phase following transplantation and so provided almost all of the specimens collected (98.8%). So it is evident that larval density reached its highest values when plant heights were lower (Fig.) In accordance with these observations this occurred during the first five weeks of stage 3. If one takes into consideration only the results obtained from the collections made during that stage, it may be observed that of a total of 603 larvae, 201 (33.3%) were collected from the inner paddies and 402 (66.7%) from their borders.

Discussion

Breeding of *An. albitarsis* larvae was recorded in the rice paddies up to five weeks after transplantion. This observation that the immature stages were found only in the early stages of the paddy growth, agrees with the findings related to other species, such as *An. culicifacies* in India and the *An. gambiae* group in Gambia (Sharma & Prasad [6], 1991; Lindsay et al.[5] 1991).

Pools in rice fields became progressively more shaded as the rice plants grew in height; beyond which, vigorous vegetative growth may cause mechanical obstruction that leads to a decrease in oviposition. At the borders of the paddies plants are not so high and there is a distance between the margin and the growing rice so insolation conditions there are more constant than in the inner field. The number of larvae collected at the paddies' border was twice that obtained from the inner area. Nevertheless, this result does not explain why, even at the paddies borders, the larvae density declined steadily after the fifth week of permanent flooding.

Anyway it seems evident that the breeding of *An. albitarsis* larvae in rice paddies is greatest during the first weeks after the start of permanent flooding when plant height is still small. It is possible that this situation lasts as long as the rice plants remain below 50cm in height (Sharma & Prasad[6], 1991). So it is consistent to expect that control measures, when applied during the early phase of rice growth, can be successful in depressing mosquito density. Nevertheless, under local conditions, it seems that *An. albitarsis* has a rapid life cycle reaching quickly high adult densities (Forattini et al.[3] 1993). So if control measures need to be applied, it is necessary to study what kind of measure is most appropiate. Chemical insecticides could have adverse effects on the bionomics of the rice field environment, killing both mosquito larvae and their natural predators. Because predator and nonpredacious populations take longer to recover than do the mosquitoes,

Table. Densities of *An. albitarsis* larvae in rice paddies during permanent flooding period corresponding to stages 3, 4 and 5 of the cultivation cycle (1993-1994)

Numbering of weeks (day, in month of collection)	Sample				Total	
	inner		border			
	N	D	N	D	N	D
Stage 3 (December— January)						
0 (13) flooding	-	-	-	-	-	-
1 (20)	*	-	88	9.8	88	4.9
2 (27)	123	13.7	224	24.9	347	19.3
3 (3)	36	4.0	30	3.3	66	3.7
4 (10)	30	3.3	13	1.4	43	2.4
5 (17)	9	1.0	40	4.4	49	2.7
6 (24)	-	-	-	-	-	-
7 (31)	3	0.3	7	0.8	10	0.6
Subtotal	201	3.7	402	6.4	603	5.6
Stage 4 (February)						
8 (7)	-	-	2	0.2	2	0.1
9 (16)	-	-	-	-	-	-
10 (21)	-	-	3	0.3	3	0.2
Stage 5 (February - March)						
11 (28)	2	0.2	-	-	2	0.1
12 (8)	-	-	-	-	-	-
13 (14)	-	-	-	-	-	-
Total	203	1.9	407	3.5	610	2.6

D - number per 10 dips.
* - not made

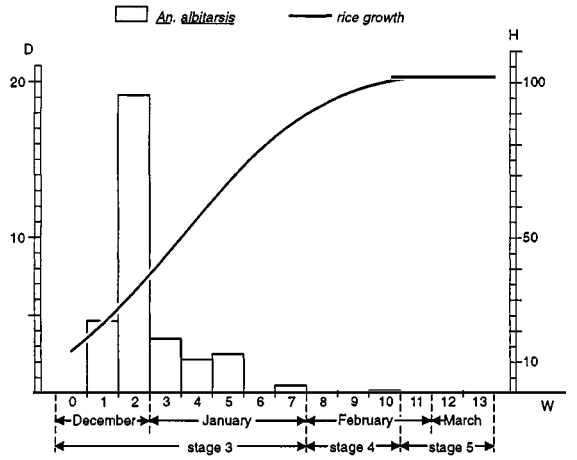

Figura: Larvae density of *An. albitarsis* and rice growth in the flooded paddies.
D - number of larvae per 10 dips
H - rice plant height in cm
W - ordinal sequence of weekly samples during the flooding period, including stages 3,4 and 5 of the rice cultivation cycle (1993 - 1994).

additional outbursts of these may happens a short time after the application of the pesticide (Asimeng & Mutinga[2], 1993). For this reason, biocontrol agents must be studied under local conditions to incorporate them into an integrated program to control mosquito breeding in the particular irrigation system.

FORATTINI, O.P. et al. Estudos sobre mosquitos (Diptera: Culicidae) e ambiente antrópico. 5- Desenvolvimento de *Anopheles albitarsis* em campos de arroz irrigados na região sudeste do Brasil. *Rev. Saúde Pública*, **28**: 329-31, 1994. Apresentam-se os resultados de observações sobre desenvolvimento da densidade larval de *Anopheles albitarsis* em criadouros representados por campos de arroz artificialmente irrigados, de dezembro de 1993 a março de 1994. Esse espaço de tempo correspondeu a período de inundação permanente iniciado com o transplante. Verificou-se relação inversa entre a densidade de larvas e a altura atingida pelas plantas de arroz. Assim, praticamente a produção das formas imaturas ocorreu ao longo das cinco primeiras semanas de inundação. O rendimento da margem dos campos de cultivo foi cerca do dobro daquele observado na área interna. Esse fenômeno não logrou explicação satisfatória apenas pelo fator insolação. Pode-se argumentar que a vegetação marginal, pela sua maior diversidade, possa oferecer maiores oportunidades de sobrevivência para as larvas, mediante abrigo e alimentação. De qualquer maneira, essas observações concordam com o verificado em outras regiões e possibilitam nortear a aplicação de eventuais medidas de controle.

Descritores: Ecologia de vetores. Anopheles. Controle de mosquitos.

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