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Mosquito Species Breeding in Ground Pools and Artificial Containers in Ajana, Ogun State, Nigeria

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ABSTRACT

During the 12 month period from August 2001 to July 2002, observations were carried out on the mosquito breeding that occurred in ground pools and a four types of test water containers – plastic, Aluminium, calabash and bamboo stumps placed in various locations in a rice field and within a village Ajana-Liyebi, Obafemi-Owode Local Government area, Ogun State, Nigeria. Eight mosquito specie were encountered in ground pools within the village and the rice field namely, *Anopheles gambiae*, n. *moucheti, An. nili, An. subpictus, Aedes aegypti, Culex tigripes, Eretmapodites chrysogaster* and *Coquilledtidia fuscopennata.* In the test containers 29 species of mosquitoes were encountered namely: *Aedes africanus, Ae. aegypti, Ae. domesticus, Ae. albopictus, Ae. unilineatus, Ae. vittatus, Ae. taylori, Ae. kunmi, Ae. simulans, Ae. luteocephalus, Ae. metallicus Ae. hirsutus, Ae. simpsoni, Ae. longipalpis, Cx. p. quiquefasciatus, Cx. dutoni, Cx. tellesila, Cx. tigripes. An. arabiensis, An. funestus, An. maculipennis, An. subpictus, Taeniorhyncus brevipalpis, Eretampodites chrysogaster, E. oedipus, Coquilletidia fuscopennata*, Coq. *mettalica, Mansonia africana* and *M. uniformis*. In the ground pools, *An. gambiae* was the most abundant constituting 38.33% of the larvae encountered and appearing in 96.0% of the positive dips. *Aedes aegypti* was the most abundant in the test containers (29.57%) followed by *M. africana* (10.10%) and *Aedes simpsoni* (9.45%). Calabash container harboured the highest number of larvae (36.0%) followed by bamboo stumps (24.2%) plastic container (23.0%) Aluminium container harboured the least number of larvae (16.8%). No significant difference was observed in the total number of larvae collected in the different sites $P > 0.05$, however the number of larvae collected from the different containers was significantly different $P < 0.05$.

INTRODUCTION

Mosquito distribution is influenced by various factors such as vegetation, climate and the availability of the right type of breeding site. For example Okorie (1970) observed that of the major species of mosquitoes in Ibadan, *Ae aegypti* had a definite preference for containers placed in a grassland macro habitat. A preliminary collection of mosquito larvae from various containers in Abeokuta metropolis by Mafiana *et al.*, (1998) revealed that the mosquitoes encountered were found breeding in tyres, domestic containers, ground pools, open drains, septic tanks, tree holes, leaf axils, rock pools and dead leaf surfaces. However domestic containers and tyres were observed to be the most common and contributed to most of the breeding of the encountered mosquito species.

As observed by Ukoli (1994) it has always been assumed that the solution of mosquito borne diseases problem lies ultimately with effective anti-mosquito measures. This is because mosquitoes have always been regarded as the weak link in the chain. However service (1993) observed that before embarking on such measures knowledge of the ecology and breeding habits and behaviour of the local species of mosquitoes is indispensable.

It is well known that in many instances the rice agro-ecosystem perfectly fits the ecological requirements for vectors of important diseases such as malaria, schistosomiasis and Japanese encephalitis that are associated with rice production in developing countries (IRRI, 1987). In spite of this rice cultivation has been on the increase in the African region including Nigeria, where the present government has stepped up rice production in order to stem the rate of importation of produce due to scarcity of foreign exchange. However according to Carnevale *et al.*, (1999) because rice fields provide suitable breeding places for *Anopheles* mosquitoes its cultivation leads to an increase in the biting rates. The species which are adapted to these sites are not the same in all parts of Africa, for example *An. funestus* is found in the ice fields of Madagascar, *An. pharoensis* in saline water rice fields in the Delta of the Senegal river, *An. arabiensis* in northern Cameroon and Burundi, *An. gambiae mopti* form in Burkina Faso and *An. gambiae* Savanna form in the rice fields of Kafina near Bouake Coted'Ivoire Carrara et al., 1990, Robert *et al.*, 1992, and Carnevale *et al.*, 1999).

Ajana Liyebi is a rice-growing village in Ogun State Nigeria. The villagers use the slash and burn method of agriculture and most fields are of a temporary nature. The in habitants grow both lowland and upland rice. The Mosquito species breeding in the rice growing areas of Ogun State. Southwestern Nigeria has not been documented. Therefore the present study reports mosquito species found breeding in Ajana, a rice-growing village in Ogun State, Nigeria.

Mosquito Species Breeding in Ground Pools and Artificial Containers

MATERIALS AND METHODS

Study site: Ajana-Liytebi is a small town approximately 40 km south of Abeokuta the Ogun State capital with about 300 inhabitants. Buildings consist of mud walls with both thatched and corrugated iron roofs. To the east of the town is a large expanse of land separated from the village by tributary of Ogun River, which is usually flooded during the rainy season. The in habitants are mainly farmers and fishermen and the major crops cultivated are lowland and upland rice, maize, cassava, and vegetables.

Collection of Mosquito larvae from Ground Pools

(i) The flooded rice field as well as ground pools within the rice field, and in the village were sampled using a plastic dipper. The dipper was lowered over the water surface and strained through a sieve of very fine mesh size. Positive dips were recorded and the larvae collected, sorted in the laboratory and kept in labelled bottles with perforated lids for ventilation.

(ii) Test Containers : In order to collect as many different mosquito species as possible four types of test containers, (bamboo sections, Aluminium bowl, plastic bowl and calabash bowl) were employed. The bamboo were nearly 12 cm in width, inside diameter and cut about 20 cm above the node while the Aluminium, plastic and calabash bowls were of 16 cm diameter and height of 14 cm. All containers were filled with one litre of water each. These were then placed in six experimental sties 4 of which were within the rice field and two within the village.

Experimental Sites

Six sites were selected four within the rice fields and two within the village.

SITE 1 – Beneath the temporary shed constructed by the farmers within the rice field, this set was protected from all sunshine.

SITE 2 – Under well-grown rice plant which form a kind of canopy over the containers: this set was also protected from sunshine.

SITE 3 – Under a tree in the rice field; this set was also under the shade.

SITE 4 – in the edge of a small clump of bushes in the rice field; this set was exposed to the sun for greater part of the day.

SITE 5 – Under a tree very close to residential buildings within the village; under the shade.

SITE 6 – At the back of a building located about 200 m from the bush and 800 m from site 5 within the village; this set was exposed to the sun for greater part of the day.

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The various containers were filled with 1 litre tap water each (transported to the village in kegs) in three replicates and placed about 200 metres from each other in each of the sites.

Collection of Larvae

The containers were examined every seven days. In making the examinations the content of each container was poured through a small mesh-sized strainer, which retained the larvae. The water was then poured back into its container. Larvae were transported to the laboratory in labelled tubes. In the laboratory, the tube lids were removed and replaced by perforated lids to allow air access in to the tubes. Larvae were identified within 48 hours using Keys provided in Christopher (1933) and larvae unable to be identified were left to emerge as adults and later identified.

Occurrence of Breeding

As the containers were placed in the study sites between August 2001 and July 2002 which period included both the dry and wet seasons the opportunity was considered favourable for observing the breeding that occurred under the conditions existing in both seasons.

RESULTS

The relative abundance of mosquito larvae collected from ground pools and the different containers is shown in Tables 1a & 1b. Mosquito larvae were collected from all test containers throughout the study period, with the highest abundance in the rainy months (April – October) both in the rice field and within the village. Also more breeding occurred in the former than the latter.

The table although also showed that the species utilized alternative containers for breeding, a marked preference was shown for oviposition in calabash containers (36.0%) followed by the bamboo (24.2%) and Plastic containers (23.0%). It was observed that most breeding took place in containers protected from sunlight. However the mean total number of larvae did not show any significant difference in the different sites ($P>0.005$).

With respect to ground pools, breeding also was highest in the rainy months. Five species were found in both containers and ground pools these are *An. gambiae, An. maculipennis, Ae. aegypti, Cx. tigripes and E. chrysogaster.*

The highest number of species (20) was collected in the month of July, followed by May, while the least was in December, January and February. However, there was no significant difference in the number of larvae collected during these months

Mosquito Species Breeding in Ground Pools and Artificial Containers

(P>0.05). In all 30 species were encountered (Tables 1a & 2). These are made up of 14 species of *Aides (Age. tailor, Age. unmet, Age. stimulants, Age. domestics, Age. cauliocephalous, Age. lagniappes, Age. hirsute* and *Age. Simpson),* 4 species of *Culex (Cox. duotone, Cox. P. quiquefasciatus, Cx. tellessila* and *Cx. tigripes),* 2 each of *Coquilletidia (Coq. metallica* and *Coq. fuscopennata) Eretmaodite (E. chrysogaster* and *E. oedipus), Mansonia (M. africana & M. uniformis)* and *Taeniorhynchus brevipalpis*

Table 1a: Mosquito species encountered in ground pools monthly between May 2001 and August 2002.

Species	Aug. 01	Sept. 01	Oct. 01	Nov. 01	Dec. 01	Jan. 02
An. Gambiae	68	73	78	10		
A. maculippenis	11	18	29			
An. Funestus	28	34	43	08		
An. Subpictus	16	18	17	08		
Ae aegypti	26	22	08			
Cu. Tigrips						
E. chrysogaster						
Coq. Fuscopennata						
Total	149	165	175	26	00	00

Table 1a Cont'd

Species	Feb. 02	Mar. 02	Apr. 02	May 02	June 02	July 02	Total	%
An. Gambiae			12	18	38	20	317	38.33
A. maculippenis				23			81	9.79
An. Funestus			27	09	22	08	179	21.64
An. Subpictus				17		23	99	11.97
Ae aegypti			24	04		10	70	8.46
Cu. Tigrips						18	42	5.08
E. chrysogaster					15	20	35	4.23
Coq. Fuscopennata		04					04	0.48
							34	6.64
Total	00	04	63	71	75	99	827	100.00

Table 1b: Relative total abundance of mosquito larva collection from (a) containers and (b) ground pools

(a)

Container	August		September		October		November		December		January	
	F	V	F	V	F	V	F	V	F	V	F	V
Aluminium	60	23	64	23	70	24	37	12	21	07	20	07
Bamboo	88	34	91	37	94	39	58	22	29	02	37	14
Calabash	103	73	106	75	109	77	69	48	33	23	42	30
Plastic	79	59	83	62	85	64	34	26	10	08	14	11
Total	330	189	344	197	358	204	198	108	93	40	113	62
	519		**541**		**562**		**306**		**133**		[illegible]	

(a) Cont'd

Container	February		March		April		May		June		July		Total		Total (%)	
	F	V	F	V	F	V	F	V	F	V	F	V	F	V		
Aluminium	36	12	47	16	50	17	53	18	54	19	57	19	569	197	766	16.8
Bamboo	44	16	49	18	71	26	73	28	77	30	84	32	795	308	1103	24.2
Calabash	48	34	74	52	88	62	94	66	96	68	101	71	963	679	1642	36.0
Plastic	26	20	44	33	51	38	56	42	57	43	60	47	599	453	1052	23.0
Total	154	82	214	199	260	143	276	154	284	160	302	169	2926	1637	4563	100
	236		333		403		430		444		471		4563			

(b)

Container	August		September		October		November		December		January		February	
	F	V	F	V	F	V	F	V	F	V	F	V	F	V
Ground pool	93	56	103	62	109	66	16	10	00	00	00	00	00	00
	149		165		175		26		00		00		00	

(b) cont'd

Container	March		April		May		June		July		Total		Total (%)
	F	V	F	V	F	V	F	V	F	V	F	V	
Ground pool	00	04	45	26	46	29	61	38	513		314		827
	04		71		75		99		513		314		827

F = Rice field, V = village

However, only the following 8 species were encountered in the ground pools – *An. gambiae* (38.33%). *An. funestus* (21.64%), *An. maculipennis (9.79%), An. subpictus* (11.97%), *Ae. aegypti* (8.46%), *Cx. tigripes* (5.08%), *E. chrysogaster (4.23%) and Coq. fuscopennat* (0.48%). *N. gambiae* was the most frequent in all positive dips in the rice field. All the collections from the ground pools were made in the rainy season as they dried up during the dry season..

A. aegypti was the most encountered (29.57%) and occurred throughout the year. *Ae. metallicus, M. africana* and *T. brevipalpis* also occurred all year round.

Larvae of two or more species were frequently encountered in one container. In all however, 6 species were seen in one occasion, 5 sp. thrice, 3 sp. nineteen times, 2 sp. sixty-eight times, and 1 sp. 252 times. The 6 sp. found in one occasion were *Ae. aegypti, Ae. albopictus, Ae. metallicus, Ae. africanus, Cx. p. quiquefasciatus*, and *E. chrysogaster.*

Mosquito Species Breeding in Ground Pools and Artificial Containers

Table 2: Mosquito species breeding in test water containers between May 2001 and August 2002.

Species	Aug. 01	Sept. 01	Oct. 01	Nov. 01	Dec. 01	Jan. 02	Feb. 02	Mar. 02	Apr. 02	May 02	June 02	July 02	Total	%
Aedes aegypti	72	33	26	78	44	01	05	08	440	109	327	204	1347	29.57
Ae. metallicus	36	09	20	20	06	10	06	04	50	38	10	60	269	5.90
Ae. vittatus		06	41	92	42	18				24			223	4.89
Ae. africanus	107	06							21	03		07	114	3.16
Ae. vittatus	40	08	69	03					22	33	06	74	255	5.59
Ae. albopictus	24									182		06	212	4.65
Ae. taylori												26	26	0.57
Ae. luteocephalus	33			06						25		96	160	3.51
Ae. simulans	37												37	0.81
Ae. domesticus	20							04					24	0.53
Ae. luteocephalus			10										10	0.22
Ae. longipalpis	41								48	61		38	188	4.12
Ae. furcifer										25			25	0.55
Ae. leopoldi												34	34	0.75
Ae. aegypti										33	69	36	138	3.03
Ae. arabiensis								06					06	0.13
Ae. subpictus									14	01	46	18	94	1.03
Ae. vexans												83	83	1.82
Ae. furcifer							31				16		47	1.03
Ae. quinquefasciatus							22		22			36	80	1.75
Ae. nigrassia												12	12	0.26
Ae. pipiens												10	10	0.22
Mansonia uniformis								26				29	55	1.21
Mansonia africana								06				03	09	0.20
Mansonia uniformis														
Coquillettidia aurites Oedipus										10			10	0.22
Culex pipiens										49	16	16	81	1.78
Culex decens africana	100	46	43	27	16	01	06	20	49	88	69	04	469	10.29
Culex uniformis	16	10						16	31	49	21		143	3.14
Culex vectorynchus	12	07	06	06	14	06	03	06	09	14	08	09	107	2.34
Culex pipiens														
Total	508	133	215	232	122	36	73	98	708	942	625	766	4558	100

DISCUSSION

A large number of ground pools were encountered both within the rice field and the village in which *Anopheles gambiae* was the most abundant and least were *Aedes aegypti* and *Coquilletidia fuscopennata. Anopheles* species are usually ground pool breeders as observed by Carnevale *et al.*, (1999), flooded paddy fields proved ideal breeding sites for the principal vectors of malaria in Africa. In all 4 Anopheles species were seen in ground pool namely *An. gambiae, An. maculipennis, An. funestus* and ***An. subpictus.*** These species were described by Ijumb and Lindsay (2001) as pioneer species, which rapidly colonize recently, flooded fields. *An. funestus* encountered in this study is also known to be associated with irrigated occurring later in the growth of rice and when the land is fallow (Marrama *et al.*, 1995).

Generally, rice fields represent ideal breeding sites for mosquitoes and they can generate large numbers of individuals (Ijumba and Lindsay 2001) as observed also in the present studies. The large number of *An. gambiae* encountered is indicative of rice fields presenting favourable breeding sites for them. Rice fields therefore are of significant epidemiological significance with respect to malaria transmission among residents of the rice field communities particularly during the rainy season when the pools support heavy breeding. *Aedes aegypti* and *Coquilletidia fuscopennata* are not known to be ground pool breeders, however, as observed by Mafiana *et al.*, (1998) ***Ae. aegypti*** can breed in almost all available sites hence it is not surprising that they were encountered in ground pools in the present study.

The Calabash container was most preferred for oviposition as it contained the highest number of larvae. This was followed by bamboo joints and plastic containers. The least attractive was Aluminium containers. The wooden nature of the calabash & bamboo may have presented better attraction for ovipositing females. The highest number of larvae was encountered in the rainy months. This is as a result of favourable conditions provided by the rain such as abundance of larval food and decrease in natural predators of adult mosquitoes, which enabled them to lay more eggs. Also, of the 2[illegible] species obtained from test containers, site 2 recorded the highest positive collections followed by site 4 . This is interesting as the two sites are quite different while site 2 was protected from sunshine site 4 was exposed to the sun or greater part of the day This could mean that sunshine does not influence oviposition however the highest positive collections observed in set 2 could be due to presence of shade for the different species.

Aedes aegypti was the most abundant species in this study as was the case in earlier investigations in Ibadan by Okorie (1970), in Lagos by Dunn, (1927) and Mafiana (1989) and Abeokuta by Mafiana *et al.*, (1998). ***Aedes aegyti*** was found

breeding in all the containers without preference for a particular one. As earlier observed. *Ae. aegypti* is known to be plastic breeding behaviour and this ability to breed in a variety of habitats, particularly small containers is thought to be partly responsible for its success. *M. africana* was also encountered in large numbers in the test containers (10.10%). *M. africana* is also a known forest breeder hence the high population observed in this study is not surprising. Apart from these 3 major species the other species encountered in the study are natural forest or plantation species hence they are more attracted to calabash and bamboo joints.

The three main species encountered in the ground pools and test containers are important vectors of diseases. ;For example, malaria, yellow fever and filariasis transmitted by *An. gambiae, Ae. aegypti and M. africana* respectively (Gillet, 1872, Maxwel *et al.*, 1990 and Robert *et al.*, 1992). This study has therefore documented the number of mosquito species breeding in ground pools and test containers in this locality.

Presently malaria is a common parasitic disease in the country, however, cases of filariasis and yellow fever in Ogun state are not too significant health consequences. Nevertheless the amount of breeding occurring in the ground pools and test water containers demonstrate the epidemiological importance of these mosquito species thus the necessity for their control.

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