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Species Abundance and Colour Preferences of Oviposition by Mosquitoes in Man-Made Containers under Field Conditions in Sokoto, Nigeria

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ABSTRACT: A study was conducted to determine the occurrence and colour preferences of oviposition by mosquitoes in man-made containers under field conditions. A total of nine (9) different colour 2 litre plastic containers were used as artificial mosquito oviposition containers. They were filled with equal amounts of water and placed in the biological garden of the Department of Biological Sciences, Usmanu Danfodiyo University Sokoto. The containers were observed for seven (7) days for mosquito larvae. A total of 319 larvae belonging to four genera, Aedes, Anopheles, Culex and Mansonia were co-habiting/ colonizing the garden. The highest occurring genus was Culex with 108 (33.9%) larvae, followed by Aedes with 92 (28.8%), Mansonia 79 (24.8%) and Anopheles with 40 (12.5%) larvae. The colour preference of mosquitoes was in this order: red 25.4 % (81), brown 20.4 % (65), black 16.0% (51), blue 13.2% (42), purple 10.3% (33), pink 7.8% (25), green 6.3% (20), yellow 0.6% (2) and white 0% (0). Although many genera oviposited in more than one colour container, the general distribution of larvae revealed that Aedes and Culex preferred red colour, Mansonia preferred brown container while Anopheles preferred black container. This study shows the importance of colour in determining the breeding sites and thus the occurrence of mosquitoes. The implications of such containers as possible breeding foci of mosquitoes of potential public health significance have been highlighted.
Key words: Colour preferences, Man-made containers, oviposition, Mosquito larvae

INTRODUCTION

Mosquitoes are the most widely spread of the medically important insects (Cheesbrough 1987). They are known to transmit diseases such as malaria, yellow fever, filariases, dengue etc. They cause much ill health and lost of human lives. Some mosquito genera responsible for such diseases include Aedes, Anopheles, Culex and Mansonia (Chandler and Read, 1961). These mosquitoes are mostly found around human dwellings.

Mosquitoes have preferential oviposition habits. Water collection, human activities and behaviour such as discarding of empty containers, planting ornamental plants around houses may potentially encourage breeding of mosquitoes (Horsfall 1972).

Oviposition is an important component of most mosquito-borne diseases (Bentley and Day, 1989). Selection of oviposition sites by female mosquitoes is a crucial event for the survival of their species. Females follow visual or olfactory cues to appropriate water collections and guided by chemical cues and physical factors in the water and assess the quality of the water before making a decision to lay their eggs (Bing *et al.*, 2004).

Despite several research works on mosquitoes worldwide, more information is required about their colour preferences particularly here in Nigeria where detailed studies have not been done in this field of interest. This study reports the occurrence and colour preferences of oviposition in man-made habitats under field conditions by female mosquitoes found in the Biological garden of the Usmanu Danfodiyo University, Sokoto. It is hoped that the study will help the government and the society at large in controlling and eradicating the spread of mosquitoes by informing them of the colours that attract mosquitoes more so that when choosing colours for day to day activities they will be selective of less attractive colours to mosquitoes.

MATERIALS AND METHODS

Experimental Containers

Two (2) litre plastic containers of different colours were filled with equal amounts of water and placed in the Biological garden of the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto under shade at 5cm interval. The colours were placed alphabetically as follows; black, blue, brown, green, pink, purple, red, white and yellow. The containers were observed daily for seven days. On each observation day all the containers were carefully observed for the occurrence of mosquito larvae.

Sampling Procedure

The content of each container was taken and poured into a clean empty bowl. The total number of the larvae were then counted and recorded. After counting, a pipette was used to transfer all the 4th stage instar larvae into a separate petridish containing some water. All the Petri dishes were transferred to the laboratory for the identification of larvae. The 1st, 2nd and 3rd instars were left till they developed into the 4th stage instar larvae (for proper identification).

Processing and identification of samples

All the 4th stage instar larvae in each petridish were picked one after the other and placed on a glass slide. A drop of water was added and covered with a cover slip. The larvae were then observed under a dissecting microscope. The larvae were then identified by their morphological features using keys given by Edwards (1941), Gillett (1972), Chandler and Read (1961) and Walker (1994).

RESULT

The result of this study shows that a total of 319 mosquito larvae belonging to four genera; Aedes, Anopheles, Culex and Mansonia were recorded. The highest occurring genus was Culex with 108 (33.86%) larvae, followed by Aedes with 92 (28.84%), Mansonia 79 (24.77%) and Anopheles with 40 (12.54%) (Fig 1).

Colour Preference of Mosquitoes

The colour preference of mosquitoes was in the order of red 81 (25.39%), brown 65 (20.38%), black 51 (15.99%), blue 42 (13.17%), purple 33(10.35%), pink 25 (7.84%), green 20 (6.27%), yellow 2 (0.63%) and white 0. Of the 81 mosquito larvae noted in the red container, 40 (50%) were Culex, 26 (32.5%), Aedes, 11(13.8%), Mansonia while Anopheles had 4 (3.7%). 26 (40%) Mansonia, 22 (33.8%) Culex, 13 (20%) Aedes and 4 6.2%) Anopheles larvae were noted in the brown container, making up for the 65 total seen in this oviposition container. Also, 20 (39.2%) of the 51 larvae seen in black container belong to Aedes, 15 (29.4%) to Anopheles, 10 (19.6%) to Culex and 6 (11.8%) to Mansonia. This shows that; (i) many genera colonized more than one coloured container for oviposition (ii) colour preference of red for Aedes and Culex, brown for Mansonia and black for Anopheles species (Fig.2).

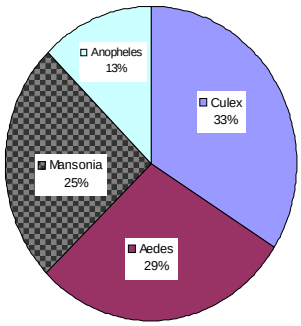

Fig. 1: Occurrence and species abundance of larvae in the container

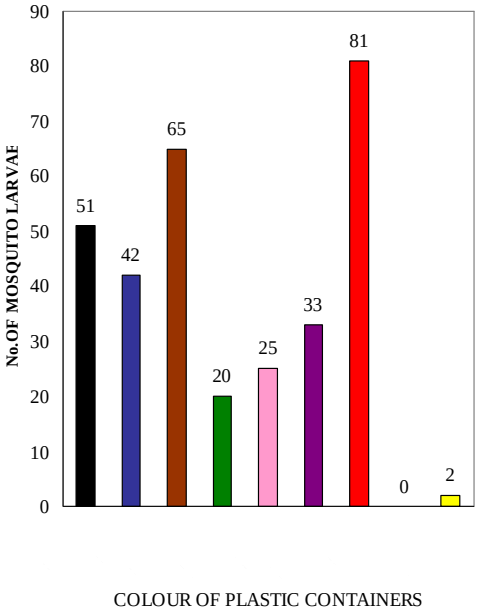

Fig. 2: The colour preference of mosquitoes.

DISCUSION

It is presently accepted by most researchers that ovipositing mosquitoes do not lay their eggs indiscriminately and that restriction of breeding habitats of a particular species, to a given habitat, is largely a result of selection preference guided by the instinct of the particular ovipositing female mosquito.

In the present study, container colour was important in influencing the oviposition choices of some female mosquitoes breeding in artificial containers in Usmanu Danfodiyo University permanent site Sokoto. Red being the most attractive colour, followed by brown, black, blue, purple, pink, yellow and white with no larva recorded. Although many genera colonized more than one coloured container, the general distribution of larvae among coloured containers revealed that Aedes and Culex frequented red container, Mansonia and Culex were more attracted to brown coloured container while Anopheles and Aedes were attracted to black container. This agrees with the works of Bates (1940) who found some Anopheles mosquitoes to show pronounced preference for dark background colours and Collins and Blackwell (2000) who reported some female mosquitoes to oviposit more frequently into red containers than into blue, green, yellow or white. Worthy of note is that Beckel (1955) and Beehler *et al*. (1992) in laboratory studies, found some Aedes females (*Aedes aegyptii*) to oviposit most frequently onto black rather than white surfaces. This present study found that Aedes mosquitoes oviposited more in red than in black container. The difference may be due to the fact that the above mentioned researchers used only two colours (black and white) in their studies, while this study involved several colours.

It is interesting to note that the preference of mosquitoes to red and Black colours has been reported by Collins and Blackwell (2000). The explanation, according to their research, was that black and red colours are known to absorb more light across most of the visible spectrum than other colours. These authors found the critical wavelength band for Toxorhynchites mosquitoes to be 300 – 600mm, and that the mosquitoes are able to differentiate between red/black and other colours. However, according to them, further studies of the visual physiology and ecology of these and other species of mosquito are required to confirm the observations.

Culex, the potential filariasis vector, was the predominant mosquito species found both in terms of number and occurrence in all the containers (33.86%). This result agrees with the observations of Gadzama (1983), who found Culex mosquitoes to be the commonest species that breed abundantly in domestic utensils in Zaria.

Another species with high frequency distribution is Aedes, which transmit dengue and yellow fever. This observation is in accordance with Hanney (1960) and Bing *et al.* (2004), who reported the frequent occurrence of Aedes larvae in domestic utensils and man-made plastic containers in Nigeria and Asia respectively. Irving-Bell *et al.* (1987) observed in Jos area, that species like Aedes and Culex are highly adapted to container-breeding.

The species with least occurrence are Mansonia with 24.77% and the principal malaria carrier Anopheles with 12.54% respectively. The relatively low abundance may possibly be due to lack of enough substrate for Mansonia adult to lay their eggs. This is because Mansonia species breed only in pools in which certain water plants grow (Chandler and Read, 1961). Anopheles hardly breed in man-made containers, but prefer natural habitat for breeding (Horsfall, 1972). Tephen and Anoviak, (2001) also showed Anopheles to colonize tree holes located in the under story than cups in tree fall gaps. Another possible reason for the low abundance of these species may be lack of enough time, in this study, to allow for long breeding and possible adaptation. Further studies are underway to evaluate effect of longer breeding time and also variety of breeding containers with different substrates to confirm this.

In conclusion, a large number of containers abound in Sokoto metropolis and may provide veritable breeding sites for mosquitoes which find steady blood meal from vulnerable population here. The status of these containers in the metropolis, as major breeding foci of disease vectors needs further investigation to determine their actual vectorial importance role. This is necessary given the endemicity of filariasis (Wijeyaratne *et al.*, 1982) and the

erratic outbreaks of yellow fever in parts of Nigeria (WHO, 1989) and also to see whether these avenues favour malaria vectors which have not been known to breed in man-made containers.

The present study contributes to the growing body of data on mosquito oviposition and the influence of colours, in addition to providing baseline data for further investigations of the visual ecology of mosquitoes.

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