International Journal of Engineering, Science and Mathematics
Vol. 6 Issue 1, March 2017,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

INSECTICIDES SUSCEPTIBILITY STATUS OF DENGUE VECTOR, *AEDES AEGYPTI* IN SELECTED AREAS OF DOON VALLEY, UTTARAKHAND.

Sundar Singh and J.V.S. Rauthan
Entomology Research Lab
Department of Zoology
D.A.V(P.G.)College, Dehradun
Uttarakhand- 248001

Abstract

Dengue fever and Dengue haermorrhagic fever are re-emerging fast as a major public health problem. *Aedes aegypti* plays a key role in dengue transmission, as a principal vector. The vector species have progressively started to developed resistance against most of the currently used insecticides. Hence, a study was carried out in dengue endemic areas of NCR during 2018 to find out the current situation of insecticide susceptibility status of *Aedes aegypti* against various insecticides under ambient room temperature of 28+2 °C and relative humidity at 70+5%. The results revealed that adult *Ae. aegypti* was resistant to DDT, tolerant to Malathion and susceptible to Deltamethrin. However, the larvae were found to be susceptible to Temephos and Diflubenzuron.

Keywords: *Aedes aegypti*, susceptibility, intermediate resistance, dengue vector NCR, insecticide

Introduction

Among the arthropods, mosquitoes are responsible for many dreaded diseases than any other groups of insects. Mosquito-borne diseases such as malaria, filariasis, dengue/dengue haemorrhagic fever (DHF), yellow fever and Japanese encephalitis contribute significantly to morbidity and mortality in many tropical and sub-tropical regions of the world.

Dengue is a major public health concern throughout the tropical and subtropical regions of the world. The World Health organization (WHO) estimates that 50-100 million dengue infectious occur each year and that almost half the world population lives in countries where dengue is endemic. It has been identified as one of the 17 neglected tropical diseases by WHO. In India, *Aedes aegypti* (Linaeus)is widely distributed and plays a key role in dengue transmission as a principal vector. Now this vector has spread to rural areas and spreading in areas which were so far free from this disease. Vector control is the main way to check dengue transmission, until a prospective vaccine against DENV is available for prevention of dengue fever (Guzman and sturiz, 2010) Insecticides play an important role in vector control for the control of dengue. In case of *Aedes* mosquito vector control is mainly confined to larval control (Ranson et al., 2010). Control of adult dengue vectors by thermal fogging is only recommended in response to dengue outbreaks. The evolution and spread of resistance to insecticides is a major concern for the control of all arthropod transmitted infections and dengue is no exception among them.

Resistance in vectors is monitored by insecticide susceptibility tests designed by WHO(1998). It is helpful in formulating the control strategies for the disease containment

But, resistance to insecticides has appeared in major insect vectors from every genus, and this is expected to directly and profoundly affect the re-emergence of vector-borne disease.

Although progress is being made on vaccine, vector control by removing larval habitats and using biological and chemical insecticides still remain the first line of defense against arboviruses (WHO, 2009). Control of adult mosquitoes using space spray application of pyrethroids and organophosphates in plural is fraught with complications, including high cost, slow operational response, ineffective timing of applications and rather low efficacy and/or residual effect. Therefore, the current study was designed to assess the susceptibility status of dengue vectors in NCR Delhi.

Materials and Methods

Study area

The study area was selected on the basis of having high prevalence rate and outbreak of dengue infection. The study was carried out in 5 localities of Dehradun viz., Dowala, Raipur, Patel Nagar and Vikash Nagar, where abundance of construction activities and increased mobility of population have added to the dengue transmission. Doiwala and Patel Nagar are densely populated where construction under different builders have been tremendous in recent past similarly Raipur and Vikash agar are huge village with population of more than one lakh .

Adult mosquitoes emerging form the -collected larvae and pupae under laboratory conditions were allowed to feed on 10% glucose solution soaked in cotton pads. The insecticide susceptibility test was done during 2015 in accordance with the guidelines laid down by the WHO standard procedures.

Different insecticides like Organochlorine (DDT-4%), Organophosphate (Malathion -5%) and Pyrethroid (Deltamethrin -0.05%) were used against one-to-two-day-old mosquitoes collected from different locations of NCR. After the requisite exposure period, the mosquitoes were transferred to recovery chamber and cotton pads soaked in 1% glucose solution was given as food during the recovery period. Control replicates were also held parallel to each test. The mortality was calculated after 24 hours. The recovery period was used for determining the susceptibility/resistance status. For larval susceptibility test III and IV stages larval collected from the field were separated and were washed in tap water and kept under observation for the period of 24 hours to detect and remove unhealthy of dead larvae. The larvae were tested against the discriminating doses dosages of larvicides viz. Tempehos (0.02 mg/l). Diflubezuron (0.025 mg/L). Brewer's yeast was given as food during the treatment period. The mortalities were calculated after 24 hours of recovery period.

The adult and larval tests showing more than 20% control mortality were discarded and repeated In case control mortality ranged from 5% to 20%, the corrected mortality was calculated using Abbot's Formula (Abott 1925) according to the guidelines of WHO.

Results

The results of the adult susceptibility test revealed that *Aedes aegypti* species was resistant to DDT as only 21.5% mortality could be obtained. Discriminating dosages of Malathion caused 86% mortality indicating tolerance of the species this insecticide. Exposure of adults to the discriminating dosages of Deltamethrin induced 98% mortality indicating that the species was susceptible to these insecticides (Table 1)

Table 1 : Results of susceptibility tests against *Aedes aegypti* using various insecticides under laboratory conditions

Insecticide	Discriminating dosages % (mgm/hr)	No. of Adult mosquitoes exposed		No. of Mosquitoes dies		Percent Mortality obtained	Susceptibility Status
		Test	Control	Test	Control		
DDT	4.0	200	50	45	2	21.6	R*
Malathion	5.0	200	50	171	1	85	T**

Deltamethrin	0.05	200	50	195	2	97	S***

R*-Resistant, T** - Tolerant, S***- Susceptible

When the *Aedes aegpti* larvae were exposed to discriminating dosages of Temephos and Diflubenzuron, 98-99% mortality of larvae was detected. It shows that Aedes aegyti larvae were susceptible to both Temephos and Diflubenzuron (Table 2)

Table 2 : Result of susceptibility tests carried out against larvae of *Aedes aegypti* using various larvicides under laboratory condition

Insecticide	Discriminating dosages % (mgm/hr)	No. of larvae expose		No. of Larvae died		Percent Mortality obtained	Susceptibility Status
		Test	Control	Test	Control		
Diflubenzuron	0.025	100	25	98	0	98	S*
Temephos	0.02	100	25	99	00	99	S*

S*- Susceptible

Discussion

Aedes aegypti has developed a strong resistance to commonly used adulticide and larvicide which necessitates continuous susceptibility monitoring for effective vector control programme. Insecticide resistance management (IRM) is crucial to maintain vector control sustainable. Studies have been undertaken by earlier investigators to assess insecticidal susceptibility status against dengue vectors in different parts of India (Katyal et al., 2001, Sharma et al., 2004; and Basal and Singh, 2006).

Temephos is organophosphate insecticide which is still effective as larvicide for controlling *Aedes* mosquito larvae. (Das et al., 2011), Widespread use of Temephos has led to the development of resistance in different countries, including Thailand and Brazil (Lima et al., 2003) Tolerance/resistance against Temephos is reported from the field collected larvae in Delhi(Singh, et al., 2011 and 201400.

In the laboratory, the aquatic stages of *Ae. aegypti* developed induced resistance to Temephos, which showed varying degree of cross resistance to Fenthion, Malathion and DDT. The expression of Temephos induced larval resistance was also observed in adult stages (Shetty et al., 2010). The immature of *Aedes* mosquito have shown the tendency of developing induced resistance to Temephos under laboratory conditions Our study is consistent with the study carried out in Ranchi city. Jharkhand and Assam in which immature stages is still susceptible to Temephos, Fenthion and Malathion (Dev et al., 2014) DDT resistance in *Ae. aegypti* was recorded for the first time in Jharia (Azeez, 1967), Bihar and others also reported the resistance of the species to DDT in different parts of the country (Madhukar, 1968, Kaul et al., 1998).

In southern India, *Ae. aegypti* was resistant to DDT and Di-p eldrin but susceptible to Propoxin, Fenitrothion, Aglathion, Deltamethrin, Permethrin and Lambdacyhalothrin (Singh et al., 2013) which is consistent with our study against Adult *Ae. aegypti* in NCR. Previous studies conducted in different parts of India have reported varying degree of resistance towards DDT and Pyrethroid (Singh et al., 2011 and Kushwaha et al., 2015). In bioassay method, 100% Adult *Ae. aegypti* mosquitoes were found to have resistant against DDT, about 8% showed resistance against Pyrethroid and 4% towards Malathion (Dhiman et al., 2014).

Conclusion

From the study it is concluded that *Aedes aegypti* prevalent in District Dehradun, have progressively started to developed resistance capability towards currently used insecticides which may bring an indication of major dengue outbreaks in this locality. There is a need to test the insecticides susceptibility status time to time to monitor and manage resistance to insecticides used in public health for the prevention and control of dengue outbreak.

Acknowledgements;

Author is thankful to head and principal, D.A.V.(P.G.)College, Dehradun for providing laboratory facilities

References

1. Abott WS. (1925).A method of computing the effectiveness of an insecticide. J. Eco, Entomol. 18:265-267.
2. Azeez SA. (1967). A note on the prevalence and susceptibility status of *Aedes* (*Stegomyia*) *aegypti* (Linn.) in Jharia, Dhanbad district (Bihar). Bull. Indian Soc. Mal. Com. Dis. 4:59-62, 4.
3. Biswas Shyamal, Kaushal K, Singh Kuldip. (1988).The Stegomyia survey and susceptibility status of *Aedes aegypti* to insecticides in Calcutta Sea port area. J. Com. Dis. 20:253-259.

4. Bansal SK, Singh KV. (2006). Laboratory evaluation for comparative insecticidal activity of some synthetic pyrethroids against vector mosquitoes in arid region. J Environ Biol. 27:251-255.

5. Dhiman S, Rabha B, Yadav K, Baruah I, Veer V. (2014).Insecticides susceptibility and dengue vector status of wild *Stegomyia albopicta* in a strategically important area of Assam, India. Parasit Vectors. 7:295.

6. Das MK, Singh RK, Dhiman RC. (2011). Susceptibility of *Aedes aegypti* Linn. to insecticides in Ranchi City, Jharkhand, India. Dengue Bull. 35:194-198.

7. Dev V, Khound K, Tewari GG. (2014). Dengue vectors in urban and sub urban Assam, India: entomological observation WHO South East Asia J Pub Health. 3(1):51-9.

8. Gokhale MD, Jacob PG, Mourya DT. (2000). Dengue virus and insecticide susceptibility status of *Aedes aegypti* mosquitoes from Belagola village, Mandya district, Karnataka state; during and post epidemic investigations. J Commun Dis. 32(4):247-253.

9. Guzman A, Isturiz RE.(2010). Update on the global spread of dengue. International Journal of Antimicrobial agents. 36:S40-42.

10. Kushwaha RBS, Mallick PK, Ravi Kumar H, Dev V, Kapoor N, Adak T, Singh OP. (2015) Status of DDT and Pyrethroid resistance in India *Aedes albopictus* and absence of knockdown resistant (kdr) mutation. J Vector Borne Dis. 52:95-8.

11. Kaul SM, Sharma RS, Sharma SN, Panigrahi N, Phukan PK, Shiv Lal. (1998).Preventing dengue and DHF. The role of entomological surveillance. J. Com. Dis. 30:187-192.

12. Katyal R, Tewari P, Rahman SJ, Pajni HR, Kumar K, Gill KS. (2001).Susceptibility status of immature and adult stages of *Aedes aegypti*, against conventional insecticides in Delhi, India. Dengue Bull. 25:84-87.

13. Lima JBP, Cunha MP, Silva Junior RC, Galardo AKR, Soares SDS, Braga IA et al. (2003).Resistance of *Aedes aegypti* to organophosphates in several municipalities in the state of Rio De Janerio and Espirito Santo, Brazil. AMJ Trop Med Hyg. 68(3):329-33.

14. Mourya DT, Gokhale MD, Chakraborti S, Mahadev PVM, Banerjee K. (1993). Insecticide susceptibility status of certain populations of *Aedes aegypti* mosquito from rural areas of Maharashtra state. Ind. J Med. Res. 97:87- 91.

15. Mukhopadhaya AK, Patnaik SK, Satya Babu P. (2006). Susceptibility status of some culicine mosquito to insects in Rajahmundry town of A.P., India. Journal of vector borne disease. 43(1):39-41.
16. Madhukar BVR, Pillai MKK.(1968). Insecticide susceptibility studies in Indian strains of *Aedes aegypti* (Linn.). Mosquito News. 28:222-225.
17. Ponlawat A, Scott JG, Harrington IC. (2005). Insecticides susceptibility of *Aedes aegypti* and *Aedes albopictus* across Thailand. J Med. Entomol. 42(5):821-825.
18. Raghavan NGS, Wattal BL, Bhatnagar VN, Chaudhury DS, Joshi GC, Krishnan KS. (1967).Present status of susceptibility of arthropods of public health importance to insecticides in India. Bull. Ind. Soc. Mal. Com. Dis. 4:209-245, 5.
19. Ranson H, Burhani J, Lumjuan N, Black WC LV. (2010). Insecticide resistance in dengue vectors. Trop Ika net. 1(1):10-15.
20. Singh RK, Dhiman RC, Mittal PK, Dua VK. (2011). Susceptibility status of dengue vectors against various insecticides in Koderma (Jharkhand), India. J. Vector Borne Dis. 48:116-8.
21. Singh RK, Haq S, Kumar G, Mittal PK, Dhiman RC. (2013). Susceptibility status of dengue vectors *Aedes aegypti* and *Aedes albopictus* in India: A review. Dengue Bulletin. 37:177-191.
22. Singh RK, Mittal PK, Gaurav Kumar, Dhiman RC. (2014). Insecticide susceptibility status of *Aedes aegypti* and *Anopheles stephensi* larvae against Temephos in Delhi, India International Journal of Mosquito Research. 1(3):69-73.
23. Shetty NJ, Minn Myin Zu, Zin Thant, Juanita SR. (2010). Insecticides susceptibility studies of mosquito larvae from Mandya District, Karnataka state. J commun Dis. 42(1):71-73.
24. Sharma SN, Saxena VK, Lal S. (2004). Study on susceptibility status in aquatic and adult stages of *Aedes aegypti* and *Aedes albopictus* against insecticides at international airport of South India. J Commun Dis. 36(3):177- 181.
25. Tikar SN, Kumar A, Prasad GB, Prakash S. (2009).Tempos' induced resistance in *Aedes aegypti* and its cross resistance studies to certain insecticides from India. Parasitol Res. 105:57-63.
26. World Health Organization, (2009). Dengue: Guidelines for diagnosis, treatment, prevention and central, 2009.

27. World Health Organization, (1998) WHO test procedure for insecticide resistance monitoring in malaria vectors, bio- efficacy and persistence of insecticides on treated surfaces. WHO/CDS/CPC/MAL/98.12, Geneva, Switzerland, 1998.