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WATER BUG *Diplonychus rusticus* (HEMIPTERA: BELOSTOMATIDAE) AS A BIOCONTROL AGENT FOR *CULEX* MOSQUITO

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AUTHOR'S CONTRIBUTION

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Belostomatid water bugs have been reported to be highly predaceous on mosquito larvae, and have been reported to kill and suck the content of the mosquito larvae. The present study aims at determining the predatory efficiency of *Diplonychus rusticus* as an efficient bioagent on *Culex* larvae. 275 adult water bugs were introduced into a pond containing 275 liters (±10%) of water. 27,500 *Culex* larvae were added. At the end of 6 hours and 24 hours the number of live larvae were collected and were noted. The results of this study proved the importance of water bug in the anti-mosquito management.

Keywords: *Diplonychus rusticus*; *Culex* mosquito larvae; biocontrol.

1. INTRODUCTION

According to the WHO expert committee [1], biological control is the direct or indirect manipulation of the natural enemies of the pest species in such a way as to increase the mortality among pest population. Mosquitoes occur throughout the tropical and temperate regions of the world. Biological control of *Culex* mosquitoes involving the use of several predators and parasites has gained momentum in recent years [2]. Many aquatic insect predators have been examined regarding their potential as biological control agents for the control of mosquito larvae. Various groups of aquatic insects such as corixids, gerrids, notonectids, nepids, belostomatids and dragonfly naiads have gained importance in the context of anti-mosquito program [3]. Of all the aquatic hemipterous insects, *Diplonychus rusticus* is reported to be a voracious predator on dipteran larvae. Hence, the present study aims at determining the biocontrol potential of *Diplonychus rusticus* on *Culex* in field conditions.

2. MATERIALS AND METHODS

2.1 Study Area

The pond at Malaipatty, Tiruchirappalli, Tamil Nadu, India was chosen as the study area. The diameter of the

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pond was 142 square feet and total water contained in the pond was 275 liters ±10%. The vegetation of the pond comprised of *Ceratophyllum*, *Hydrilla* and *Pistia* species.

2.2 *Diplonychus rusticus*

Adults of *Diplonychus rusticus* were collected from the nearby ponds, Tiruchirappalli, using a hand net. The water bugs were transported to the laboratory in plastic buckets containing water. In the laboratory the water bugs were maintained in an aquarium containing *Hydrilla* twigs. *Culex* larvae used as prey were collected from stagnant water bodies using a hand net and transported to the laboratory in plastic buckets containing water.

2.3 Survivability of *Culex* Larvae in the Laboratory

In the laboratory, one adult *Diplonychus rusticus* was taken in a glass trough containing 1 liter aged tap water and 100 *Culex* larvae. Survival rates of the mosquito larvae were noted after 6 and 24 hours.

2.4 Survivability of *Culex* Larvae in the Field

Using the dip method, a control was done by introducing 27,500 mosquito larvae in the pond in the absence of adult water bugs. The experiment was conducted for 20 days. Using the dip method, the survivability of the larvae was noted after 6 and 24 hours. On completion of the control, remaining mosquito larvae in the pond were removed using a hand net. 275 adult *Diplonychus rusticus* were starved for 24 hours prior to the start of the experiment, were introduced in the pond. Using the dip method, 27,500 mosquito larvae were added. The experiment lasted 20 days. Survival rate of the larvae were noted after 6 and 24 hours. Data obtained was subjected to student's `t' test to determine their significance (p value- 0.05).

3. RESULTS

Table 1 displayed the survival rate of *Culex* larvae in the laboratory, field and control over a period of 6 and 24 hours. In the laboratory, at the end of 6 hours, 88 mosquito larvae were noted on day 1. The survival rate increased to 90 on day 4. A gradual decrease to 59 was noted on day 8. Days 9, 10, 11 and 12 showed an increase in the survival rate of the mosquito larvae. Day 15 recorded a high survival rate of 81 which increased to 89 and 85 on days 19 and 20 respectively. At the end of 24 hours, day 1 recorded a survival rate of 12 mosquito larvae. This increased to 48 on day 7 and 56 on day 9. A slight decrease in the survival rate to 25 was noted on day 12. This increased to 51 on day 14 and decreased to 13 on day 16. Day 17 recorded a survival rate of 59, with a low survival rate of 15 being recorded on day 20.

In the field, after 6 hours, day 1 recorded a survival rate of 51 larvae. A decrease to 11 and 13 was noted on days 4 and 13 respectively. The survival rate increased to 41 on day 8 with a high rate of survival 75 being recorded on day 9. Days 12 and 13 recorded a low survival rate of 10 mosquito larvae. An increase was noted on days 14 and 15 with a decrease to 11 on day 16. Day 20 recorded the highest survival rate of 94 mosquito larvae. The control readings showed 100% survivability on days 2, 7, 16 and 16 with a negligible mortality rate on the remaining days. At the end of 24 hours, day 1 recorded a survival rate of 55 which lowered to 18 on day 4 and 12 on day 6. An increase in the survival rate to 84 and 80 was noted on days 8 and 9 respectively. A very low survival rate of 6 and 8 was noted on days 12 and 13 respectively. This showed a gradual increase to 59 and 67 mosquito larvae on days 18 and 19 respectively. Negligible mortality rate of mosquito larvae was noted in the control. Table 2 highlighted the statistical analysis (t-test) that showed significant results for both 6 and 24 hours readings.

4. DISCUSSION

The use of natural enemies to control pest populations has always been an empirical business. Ecology and biological control have started to produce new techniques that may be useful, such as the modeling of the entire pest situations [4]. Studies on the survivability of *Culex quinquefasciatus* larvae reveal that in the laboratory, the survival rate of the larvae was high when compared to the field. In the 6 hour readings, low survival rate was noted on days 8 in the laboratory. In the 24 hour readings, the survival rate lowered on days 1, 12, 16 and 20.In the field, the survivability of the mosquito larvae was low in the presence of the adult *Diplonychus rusticus* when compared to that of the control. In the field, in the presence of the adult water bug, low survival rates were noted on days 4, 12, 13 and 16 in 6 hour treatment. In the 24 hour treatment, low survival rates were noted on days 4, 6, 12 and 13.Results reveal that the survivability of the mosquito larvae was higher in the laboratory when compared to the field. This could be due to the fact that in the field the predators exhibit a high rate of competition in high prey densities leading to a higher attack rate and a low handling time [5]. In the laboratory, a single adult water bug is present in 1 liter of water. Since there is no threat of competition, the predator exhibits a low attack rate and longer handling time [6]. Hence, as suggested by Holling [7], in the laboratory, the handling time of the predator affects the predation response by decreasing the time available for active search. Inspite of different

Table 1.Survivability of *Culex* larvae/dip

Days	Period of exposure					
	6 Hours			24 hours		
	Laboratory	Field	Control	Laboratory	Field	Control
1	88	51	98	12	55	95
2	75	54	100	27	48	97
3	80	45	99	24	49	94
4	90	11	99	19	18	96
5	89	13	97	22	20	91
6	79	24	98	31	12	97
7	67	36	100	48	19	96
8	59	41	99	39	84	93
9	74	75	96	56	80	91
10	69	54	98	41	60	95
11	76	20	99	40	31	97
12	69	10	99	25	6	98
13	56	10	97	43	8	94
14	79	53	99	51	12	95
15	81	46	100	27	39	99
16	75	11	100	13	19	98
17	68	29	96	59	36	91
18	79	36	99	26	59	96
19	89	56	97	30	67	93
20	85	94	98	15	32	94

Table 2. Student `t' test

Parameters	Calculated `t'	
	6 hours	24 hours
Between Field and Laboratory	6.766*	7.217*
Between Control and Field	11.598*	10.613*
Between Control and Laboratory	10.146*	5.996*

**significant; df = 38; t = 1.645 at 0.05 % level of significance*

ecological requirements of these biocontrol agents, they exert predation pressure on the mosquito population and help in stabilizing the population at a lower level [8]. Though many biocontrol agents can be identified, the most important criterion is the judicious selection of the most potential agent that should become effective in the Integrated Vector Control Operation [9].

5. CONCLUSION

The conclusion drawn from this research work is that the water bug *Diplonychus rusticus* is a good control agent for the vector *Culex* mosquito and it can be used effectively in the field.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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