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"STUDY ON EFFICACY OF CYPERMETHRIN ON THE BIOLOGICAL PARAMETERS OF CALLOSOBRUCHUS CHINENSIS LINNAEUS".

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1. Abstract:

Pesticides are documented to have strong impact on the physiological, biological, biochemical and morphological parameters of insects. This study reviews the sub-lethal impact of Cypermethrin (a synthetic pesticide) on various biological parameters of *Callosobruchus chinensis*. The designed insect was exposed to sub-lethal dose of Cypermethrin. The exposure did not produce immediate mortality of the insect, but had prolonged effects on its biological parameters. The laboratory analysis was carried out with LC10, LC20 and LC30 of the designed pesticide at a room temperature of 25-27 ^{o}C and relative humidity of 60-70%. The mean rate of oviposition decreased from control = (96 ± 2), LC10 = (92 ± 2) to LC20 = (79 ± 2) and LC30 = (63 ± 3). The percentage of egg development into larvae showed significant decline from control = (94%) to LC10 = (81%), LC20 = (67%) and LC30 = (55%) respectively. In the same way the percentage of adult emergence from the 4th instar larvae of *C.chinensis* showed significant decline from control (95.00 ± 2.00%), LC10 (88.00 ± 2.50%), LC20 (55.00 ± 2.60%) and LC30 (40.00 ± 2.85%). Similarly the mean life span (in days) of adult females decreases from control = 12.50 ± 0.125 to LC10 = 8.25 ± 0.190, LC20 = 6.50 ± 0.150 and LC30 = 4.30 ± 0.125. Although chemical pest control method is quick, easy and inexpensive, but it is associated with several adverse effects on environment therefore in view of the environmental modifications that have significantly impacted our ecosystem, insect population and other beneficial non-target organisms, it is necessary to evaluate the lethal and sub-lethal effects of many pesticides frequently, as this will help to determine the dose response status of insect pests for preference and design of chemicals for control programme.

Key words: ***Callosobruchus chinensis*, storage pest, cow pea, synthetic pesticides, sub-lethal, oviposition, larva, adult, life span.**

2. Introduction: *Callosobruchus chinensis* is a common species of beetle belonging to bean weevil subfamily. The species is known by other names like pulse beetle, Chinese bruchid and cowpea bruchid (Chandra and Girish 2008). It is known to be pest in nature, commonly invading different species of stored legumes (Srinivasan and Durairaj 2008). Due to their universal legume diets and widespread distribution, it is considered to be one of the most detrimental pests of stored legume industry (Yanagi 2013). Due to their strict nature of feeding only on legumes, the larval as well as adult forms are usually found on legumes. Some of the common host plants of *C. chinensis* include green gram, lentils, cow-pea, pigeon-pea, chick-pea and other pea species (Neog 2012). The larvae of the *Callosobruchus chinensis* are yellowish-whitish in colour with reduced legs. The pupae are dark brown and pupation occurs inside the legume. To fight the pest has remained a challenge for scientists, farmers and other growers. Several methods of pest control are currently in use to reduce the crop damage, but effective control is still a distant dream for researchers and farmers as well. Chemical pest control is considered to be effective but it puts several lethal environmental stresses. The inappropriate application of pesticides in agricultural fields as well as in the specific stored rooms has led to the development of resistance against the pesticide among the pest population, putting negative impacts on the environment factors, human health and other beneficial non-target organisms (Hemingway 2000). Therefore before applying chemicals to control the pest it is obligatory to use the chemical in small amount and in appropriate manner. At the same time, it is essential to study the biological parameters of the pest insect which may assist to know how a pesticide can act and which biological parameter is more susceptible to pesticide. The chemical method of pest control is preferred over other pest control methods because it is easy to use, inexpensive, and yields instant result.

Pyrethoids are considered to be the most successful classes of insecticides. These pesticides are neurotoxic and share structural similarity to that of Pyrethrins which are synthetic equivalents of natural pesticides like Pyrethrins obtained from *Chrysanthemum cinerariifolium* (Killeen et al 2004). These chemicals are used to control pest insects including beetles and other medically important insect species. In comparison to organochlorines and organophosphate pesticides which have severe toxicity to mammals, pyrethoids have high bio-efficacy and are relatively low toxic, therefore these chemicals emerged as a major class of highly active insecticides (Wirtz et. al 2009). The study is significant as it reassess the sub-lethal effects of cypermethrin on some key biological parameters of *C.chinensis* in order to update our knowledge on the current dose response status of insect pest and reassess the preference and design of the chemical for pest control programme.

3. Materials and Methods: The *C. chinensis* colony was raised from the different collections of the cowpea seeds brought from market. The adults raised from different colonies are mixed to start a fresh culture. About 30 randomly chosen pairs of about 1 to 3 day old adult bruchid are placed in wide-mouthed jars. Each jar contains about 0.5 kg of fresh cow-pea seeds. The jars are later covered using a fine transparent and porous cloth to prevent the insect from escaping and to permit gaseous exchange. These adult flies were allowed to mate for one week under laboratorical conditions in order to complete the oviposition. The temperature in the laboratory is maintained at around 25-27^{o}C, with relative humidity 60-70%. After the deposition of eggs the beetles are removed from the experimental jars using an aspirator. Now the eggs deposited into the jars are monitored carefully for hatching and completion of life cycle and until the emergence of adults. The same procedure is repeated multiple times to raise several generations before carrying out bioassay experiments. The experiment was carried from August to December 2018. The designed insect used for the bioassay was identified as *Callosobruchus chinensis* linn. By Dr. Ajay P. Tribhuwan, Associate Professor, Department of Zoology Swami Muktanand College of Science Yeola, District Nasik Maharashtra.

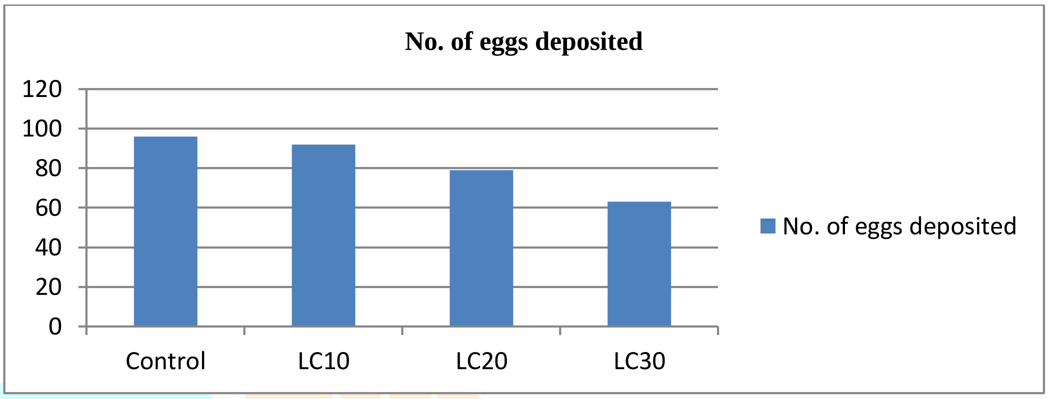
4. Data analysis: The mean oviposition rate, egg development, larval eclosion to adults and life span were compared to in all treatments with control using Analysis of Variance ANOVA. The statistical analysis was run using computer version software SPPS version 21.0.

5. Result: The sub-lethal effects of cypermethrin on various biological parameters of *Callosobruchus chinensis were determined* and the results are discussed here as under

5.1: Sub-lethal effects of cypermethrin on the rate of Oviposition: The experimental insect showed variation in the rate of oviposition when exposed to the sub-lethal dose of cypermethrin from LC 10 to LC 30 and that of control. Number of eggs deposited by female beetle declined significantly from LC 10 to LC20 and simultaneously from LC20 to LC30 as shown in the table below.

Concentration	Number of eggs deposited
Control	96 ± 2
LC_{10}	92 ± 2
LC_{20}	79 ± 2
LC_{30}	63 ± 3

Tab.1: Shows Sub-lethal effects of cypermethrin on the rate of oviposition.

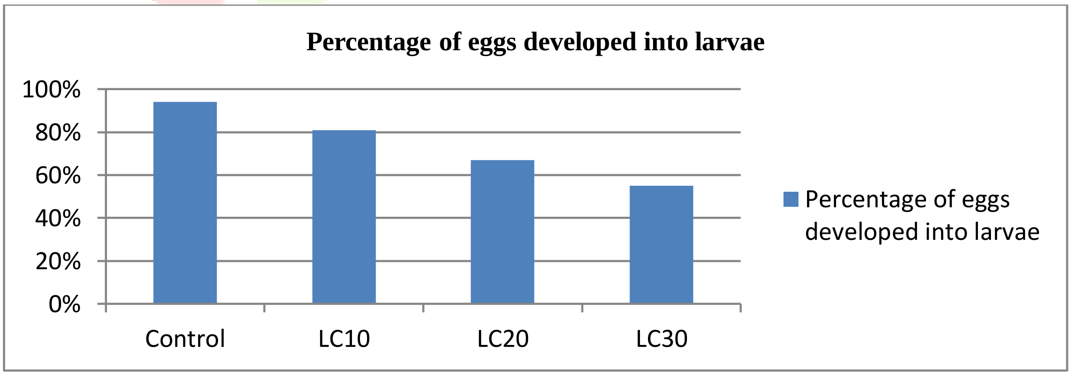


Graph 1. The graph shows the number of eggs deposited in control and after exposure to sub-lethal concentration of cypermethrin.

5.2: Sub-lethal effects of cypermethrin on the percentage of egg development: The percentage of egg hatching of the experimental insect showed variation from LC10 to LC30 and to that of control. The percentage of egg hatching showed significant decline from LC 10 to LC20 and simultaneously from LC20 to LC30 as shown in the table below.

Concentration	Percentage of eggs developed into larvae
Control	94%
LC_{10}	81%
LC_{20}	67%
LC_{30}	55%

Tab.2: Shows Sub-lethal effect of cypermethrin on percentage of eggs developed into larvae.

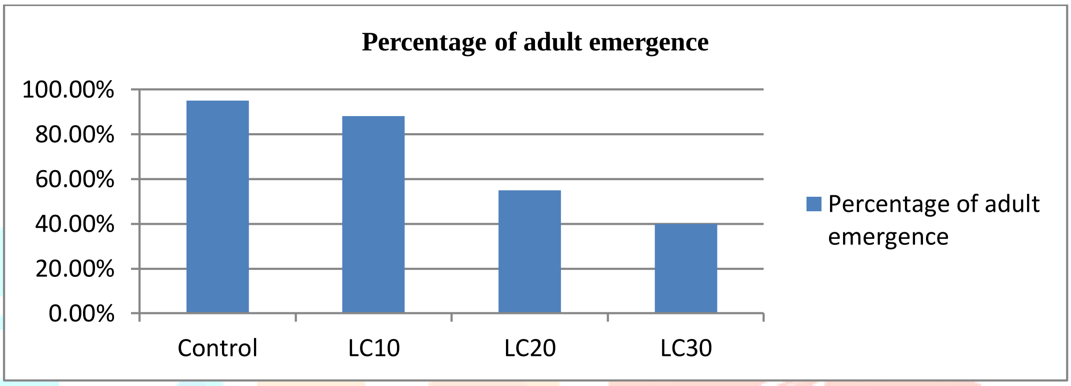


Graph 2: The graph shows the percentage of egg development in control and after exposure to sub-lethal concentration of cypermethrin.

5.3: Sub-lethal effects of cypermethrin on adult emergence: The percentage of adult emergence from the larvae showed significant variation from LC10 to LC30and to that of control. The number of larvae developed into adults showed significant decline from LC 10 to LC20 and simultaneously from LC20 to LC30 as shown in the table below.

Concentration	Percentage of adult emergence
Control	95.00 ± 2.00%
LC_{10}	88.00 ± 2.50 %
LC_{20}	55.00 ± 2.60%
LC_{30}	40.00 ± 2.85%

Tab.3: Shows Sub-lethal effect of cypermethrin on percentage of adult emergence.

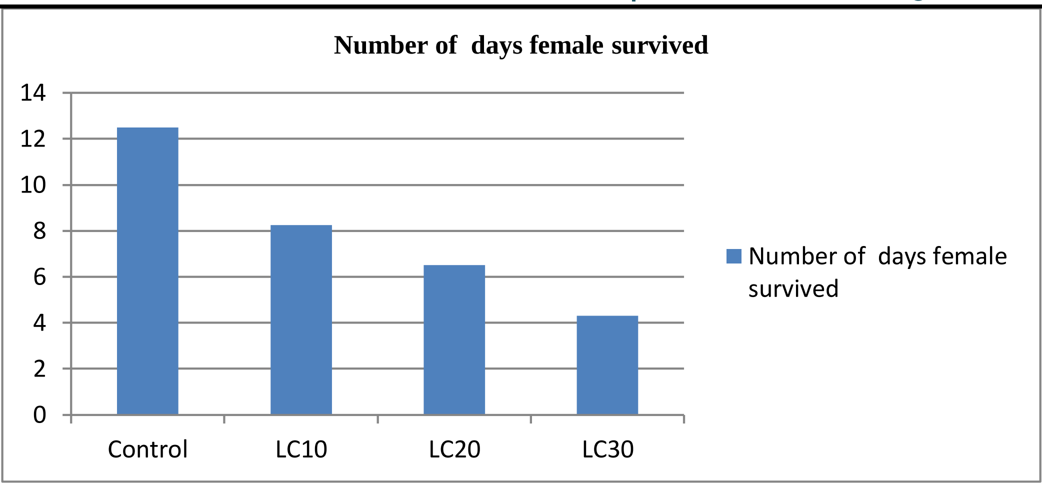


Graph 3: The graph shows the percentage of adult emergence in control and after exposure to sub-lethal concentration of cypermethrin.

5.4: Sub-lethal effects of cypermethrin on Life span of adult female *Callosobruchus chinensis:* After emergence from the larvae, the adults usually live for about two weeks. But during the experimental study the adults when exposed to varying sub-lethal concentration of cypermethrin showed variation in life span from 12.50 ± 0.125days in control, 8.25 ± 0.190 days in LC10, 6.50 ± 0.150 days in LC20 and 4.30 ± 0.125 days in LC30 respectively. Thus the maximum number of days female survived is 8.25 ± 0.190 in LC 10 and minimum number of days the female survived is 4.30 ± 0.125 in LC30. Thus it is clear that with the increase in sub-lethal concentration of cypermethrin life span of the adult female significantly decreases as depicted in the table.

Concentration	Number of days female survived (days)
Control	12.50 ± 0.125
LC10	8.25 ± 0.190
LC20	6.50 ± 0.150
LC30	4.30 ± 0.125

Tab.4: Shows Sub-lethal effect of cypermethrin on life span of female *C.chinensis*.



Graph4: The graph shows number of days the female survived in control and after exposure to sub-lethal concentration of Cypermethrin.

Thus the result of this study indicate that with the increase in the sub-lethal concentration of cypermethrin there is significant decline in various biological parameters of *Callosobruchus chinensis,* hence decline in its population. Therefore, we recommend use of cypermethrin to control pest insects like beetles including other medically important vectors and insects provided the designed chemical is applied in minimum quantities and in an appropriate manner to avoid environmental stresses and to protect the beneficial and non-target organisms.

6. Conclusion

The experiment was designed to enumerate the impact of cypermethrin on the biological parameters of *Callosobruchus chinensis*. The study proved that the designed pesticide is effective in controlling the pest insects. The exposure of the experimental insect to the given concentration of cypermethrin proved to be significant as it induced several biological stresses. The designed pesticide produced a significant sub-lethal impact with varying degree of changes when it was applied in very small quantities. Although the application of cypermethrin in a low amount did not result in instant death of the pest but led to the steady and prolonged manifestation of disruption in various biological parameters such as decline in rate of oviposition, delayed egg development and delayed in adult emergence. The treatment of the pest insect with cypermethrin led to its reduced life span. The use of pesticides is associated with several side effects; therefore it is recommended that there should be regular assessment of toxicities of frequently used insecticides to overcome on the changes that are continuously transforming the insect population through environmental stress. This will be helpful in designing chemicals for effective control of Pests insects without exerting stress on environmental factors.

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