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Beitr. Ent. · Bd. 19 · 1969 · H. 3/6 · S. 643–646 · Berlin

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Water loss from *Leogryllus bimaculatus* SAUSSURE treated with certain insecticides and under certain other experimental environmental conditions

(Saltatoria: Gryllidae)

A number of workers, as JORDAN (1927), GUNN (1933), BUXTON (1932) and MELLANBY (1934) believe that most of water loss in insects takes place through spiracles. RAMSAY (1935) has shown that at temperatures above 30 °C the body surface of cockroach becomes more permeable to water due to a phase change, probably, melting of a layer of some waxy or fatty substance naturally occuring on insect cuticle. Workers like BEAMENT (1945), RICHARDS (1953) and WIGGLESWORTH (1945) hold the view that the water is lost through the integument but is controlled by the waxy protective layer occuring on surface of integument. Water loss following insecticidal treatment also has been recorded by some previous workers as WIGGLESWORTH (1945) and INGRAM (1955) in pyrethrum treated insects, BUCK & KEISTER (1949) in DDT treated blowflies and CHATTORAJ & SHARMA (1964) in *Periplaneta* treated with certain insecticides. WIGGLESWORTH (1945) has considered this loss of water to be due to "spasmodic muscular contraction" which has been regarded by INGRAM (1955) to be "hyperactivity" but CHATTORAJ & SHARMA (1964) consider that the hyperactivity, though occuring in the treated insects, cannot be the only cause of water loss.

The present series of experiments were conducted to see water loss in *Leogryllus bimaculatus* SAUSSURE under certain experimental environmental conditions and following treatment with certain insecticides.

Air, previously dried by passing through calcium chloride tube, was passed over the experimental and control insects to absorb any water droplets from body surface. The air was again passed through another calcium chloride tube to collect the water. The water droplets could be observed adhering to inner side of the glass tubing. This method left the insect almost perfectly dry for weighing. The experimental and control insects were weighed before and after running the experiment. Loss in body weight was recorded by noting the difference in weight of insect before and after the experiment. The change in body weight was regarded to be due to water loss.

1. In order to study the role of spiracles in the evaporation of water, the spiracles were kept artificially open by introduction of CO_2 in air. The water loss was much greater in the experimental insect than in control. This indicates that greater water loss would occur if the spiracles are kept open by external or internal stimulus.

2. Experiments conducted to study water loss at different temperatures indicated that while the difference noted in experimental and control insects was not appreciable upto about 35 °C yet beyond it there was a marked rise in water

DOI: 10.21248/contrib.entomol.19.3-6.643-646

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loss. This shows that at high temperature the water loss is enhanced. This, however, does not necessarily confirm that it is because of a phase change of the outer protective layer of the cuticle because there does exist another possibility of forced opening of the spiracles at high temperatures.

3. In order to study the role of cuticle in conservation of body water, the upper surface of cuticle was abrased by treatment with an inert dust, Neosyl. The water loss showed a remarkable increase in abrased insect as compared to the control. This shows that the cuticle does have an outermost water proofing layer and if this is damaged there would occur a marked increase in water loss.

4. For the study of effects of insecticides, aldrin, lindane, Nicotene sulphate, endrin, DDT and dieldrin were used. The insecticides were applied in decisive lethal doses so as to give a cent percent knock down within an hour and the insects passed in moribund condition directly from this stage within the next hour. The treated insects exhibited great restlessness and increased muscular activity and the body surface presented a wet appearance all over, being not localised to the area of the treatment. The treated and control untreated insects were exposed to the current of dry air for 3 hours. Weight of the treated insects before and after the exposure to dry air indicated the water loss and this was indicated in percentage to body weight. The control insects did not show any wetness over body surface and any appreciable change in body weight. The percentage of water loss differed with insecticide to insecticide and was high in all treatments.

5. Experiments were also conducted to see water loss from insecticide treated insects under chilled condition. Insects were cooled by keeping them in ice containers. Some of these were treated with insecticides and others were used as controls. These experiments showed that while water loss was reduced under chilled conditions as compared to at room temperature yet it was sufficiently high when compared to the water loss in control insects.

6. That the loss in body weight was due to loss of body water was tested by noting the difference of weight of a lot of insects treated with insecticide as well as of the calcium chloride tube collecting the released water, before and after the experiment.

The results of these experiments suggest that there occurs a water proofing mechanism in the cuticle of the insect. Normally, due to presence of this water proofing covering a perfect water conservation is affected. The spiracles do not remain open permanently but open just sufficient enough to admit requisite amount of air. If, however, either the water proofing mechanism in the cuticle be broken or the spiracles be kept forced open, greater loss of water would occur from the insect. Besides, water loss may also be taking place through mouth and anal openings. Enhanced water loss occurs from the insect treated with the insecticides. This water loss, probably, occurs both from spiracles as well as entire body surface, besides the mouth and anal openings. The site of water loss is not localised to the area of treatment. The treated insects appear to be hyper-

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active but whether this hyperactivity is the sole cause of water loss, is not definite. The insecticides probably set forth acute physiological upsets and initiate chemical reactions which may be responsible for the water loss, either through hyperactivity or by direct action, in affecting water loss either through increased spiracular openings or through increased permeability of cuticle, most probably, through both these devices. Different insecticides affect the insects to different degrees, hence the amount of water loss differs with different insecticides.

Summary

These investigations reveal that water conservation in *Leogryllus bimaculatus* SAUSSURE is affected both by the limited openings of the spiracles and the impermeable nature of the cuticle. If any of these mechanisms is disturbed, considerable water loss may occur. The investigations also show great water loss from the insect following treatment with a number of insecticides.

Zusammenfassung

Diese Untersuchungen decken auf, daß die Flüssigkeitshaltung bei *Leogryllus bimaculatus* SAUSSURE von den beschränkten Öffnungen der Luftlöcher und der undurchlässigen Natur der Oberhaut (cuticle) beeinflußt ist. Wenn dieser Mechanismus gestört ist, wird ein bedeutender Flüssigkeitsabgang (water loss) eintreten. Die Untersuchungen zeigen auch solch einen großen Verlust durch Behandlung mit Insektiziden.

Резюме

Исследования показывают, что консервация воды у *Leogryllus bimaculatus* SAUSSURE зависит от органиченных отверстий спиракулей и от непроницаемости поверхностной кожи. Если нарушается этот механизм, возникает большая потерия воды. Исследования показали, что после применения инсектицидов имеется высокая потерия воды.

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DOI: 10.21248/contrib.entomol.19.3-6.643-646

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DOI: 10.21248/contrib.entomol.19.3-6.643-646

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Zeitschrift/Journal: Beiträge zur Entomologie = Contributions to Entomology

Jahr/Year: 1969

Band/Volume: 19

Autor(en)/Author(s): Srivastava Rahul

Artikel/Article: Water loss from Leogryllus bimaculatus Saussure treated with certain insecticides and under certain other experimental environmental conditions (Saltatoria: Gryllidae). 643-646