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## Further studies on the induced haemotological changes in treated insects

TAREEVA & NENJUKOV (1931) have described the blood picture of sodium arsenate and sodium fluoride poisoned blood of *Calliptamus italicus*. PILAT (1935) described the blood picture of poisoned *Locusta migratoria* with sodium arsenate and sodium fluoride. YEAGER & MUNSON (1942) studied extensively the blood cells of poisoned *Prodenia eridania* larvae with 15 insecticides. TOUMANOFF & LAPIED (1950) have described the blood cell changes in *Galleria* after DDT administration. JONES & TAUBER (1954) described the blood cell counts and blood cell picture of *Tenebrio molitor* LINNAEUS larvae with the treatment of DDT, nicotine, fluorides, and other substances. CHATTORAJ & SHARMA (1965) have described the poisoned blood picture of grasshoppers, cockroaches, and *Attacus* larvae with DDT, parathion, methoxychlor, dimecron, dieldrin, and lindane poisoning.

### Material and Methods

The insecticides selected for this study were: aldrin, allethrin, endrin, nuvan, phosdrin, and sevin; and the insects were the adult cockroaches *Periplaneta americana* (LINNAEUS), nymphs of grasshoppers *Poecilocerus pictus* FABRICIUS, and larvae of *Prodenia litura* FABRICIUS. The insects were reared in the laboratory. The insecticides were prepared in different concentrations and applied topically to the cockroaches and grasshoppers and by injection to the larvae of *Prodenia*. The blood was taken out by amputing the antennae of cockroaches and grasshoppers and by amputing the prolegs of the larvae. The blood was heat fixed *in vivo*, a thin smear prepared on the slide, stained with either WRIGHT's stain, LEISHMAN's stain, or haemotoxylin eosin stain, dehydrated and mounted. The control experiment were also run concurrently with untreated experiment for comparative study.

### Observations

The observations have been reported after comparing them with the haemocytes of the untreated and control run insects. The blood cells of the untreated insects are round or fusiform, have uniform boundary and their nuclei lie in the centre. The haemocytes are evenly stained.

The action of insecticides on the blood cells of grasshoppers, cockroaches and *Prodenia* larvae are of generalized nature. The variation has been observed only in the intensity of the haematological changes. Following is the account of the induced blood cell changes observed with the application of insecticides.

The application of insecticides causes decreases in the visibility of normal structures of cytoplasm. The haematological changes observed in the blood cells of grasshoppers and cockroaches are: cell agglutination, appearance of microhaemocytes and megalohaemocytes, abnormal haemocytes (poikilo-haemocytes) and formation of plastids; the cytoplasm becomes ragged, dissolved and shows the appearance of black granules. The nuclear degenerations involved: atrophy, hypertrophy, swelling, extrusion, pycnosis, vacuolation, distortion, rupture and dislocation. Changes in the *Prodenia* larvae are observed as: cell agglutination, contraction of cytoplasm, fusiform cells become round, plastid formation, uneven staining and surface irregularities; and the nuclei appear swollen, hypertrophied and overlapped with cytoplasmic folds.

The changes observed with these insecticides are of the same type and nature as have been reported by CHATTORAJ & SHARMA (1965).

Table 1

Showing the details of the treatments

Serial No.	Insecticides	Doses applied in microgram/gm of the body weight		
		Cockroaches	Grasshoppers	<i>Prodenia</i> -larvae
1.	Aldrin	75.70	21.79	8.75
2.	Allethrin	58.10	24.67	8.61
3.	Endrin	72.20	29.89	9.49
4.	Nuvan	67.00	28.60	6.87
5.	Phosdrin	80.45	35.34	7.26
6.	Sevin	57.55	28.05	7.97

Table 2

Showing the comparative blood cell changes

Serial No.	Insecticides	Grasshoppers		Cockroaches		<i>Prodenia</i> -larvae	
		Cytoplasm	Nuclei	Cytoplasm	Nuclei	Cytoplasm	Nuclei
1.	Aldrin	+	++	+	++	++	+
2.	Allethrin	++	+++	++	+++	++	++
3.	Endrin	++	+++	++	+++	++	+
4.	Nuvan	+	++	+	++	++	+
5.	Phosdrin	++	++	++	++	++	+
6.	Sevin	++	+++	++	+++	++	++

### Conclusions

1. The action of insecticides in the blood cells of *Prodenia* larvae causes a general shrinkage of the cytoplasm and pseudopodia like structures come out

of the blood cells; there are no vacuoles and most fusiform cells become round. In haemocytes of grasshoppers and cockroaches the conspicuous haematological changes are observed as: formation of microhaemocytes, megalohaemocytes, abnormal haemocytes, and the presence of abnormally large granules.

2. The nuclei of the blood cells of *Prodenia* larvae are not much damaged excepting that they are dislocated, lie overlapped by cytoplasmic folds, deeply stained and hypertrophied. But in the blood cells of grasshoppers and cockroaches nuclear degenerations are observed as: raggedness, rupture, atrophy, hypertrophy, pyknosis, vacuolation, dislocation, swelling and extrusion.

3. The insecticides cause: decrease in the visibility of normal structures of cytoplasm, agglutination of blood cells, and the decrease in flow in amputated insects.

4. The intensity and the type of pathology varies as much with the insect as with the insecticide and its dose.

5. Little haematological changes are observed after the administration of aldrin and nuvan; marked changes are observed with the application of phosdrin and endrin; and intense haematological changes are observed after the administration of sevin and allethrin.

6. Intense shrinkage and presence of pseudopodia like structures in the blood cells of *Prodenia* larvae is probably due to the direct contact of insecticides and the apparent water loss from the body of the treated larvae.

7. It has been concluded, that unless suitable and precise standard methods of blood cell changes are evaluated, it is very difficult to describe the induced haematological changes owing to the difficulty of passive active transformations, degenerative and regenerative changes, blood cell variation in different groups of insects, induced blood cell variations, and unspecific action of insecticides on the blood cells.

### Summary

Haematological changes caused by the application of aldrin, allethrin, endrin, nuvan, phosdrin and sevin were studied on adults of *Periplaneta americana* (LINNAEUS), nymphs of *Poecilocus pictus* FABRICIUS, and larvae of *Prodenia litura* FABRICIUS. The action of the insecticides on the insects produced various types of abnormalities that were not specific to the insecticides. The changes observed were of the same type as reported by CHATTORAJ & SHARMA (1965). It was observed that only slight haematological changes were caused by the application of aldrin and nuvan; marked changes were caused by the application of phosdrin and endrin; and intense haematological changes resulted from the application of sevin and allethrin.

### Zusammenfassung

Haematologische Veränderungen, bewirkt durch die Anwendung von Aldrin, Allethrin, Endrin, Nuvan, Phosdrin und Sevin, wurden untersucht bei Imagines von *Periplaneta americana* (LINNAEUS), bei Nymphen von *Poecilocus pictus* FABRICIUS und bei Larven von *Prodenia litura* FABRICIUS. Die Insektizide bewirken bei den Insekten verschiedene Typen von Abnormitäten, die aber nicht spezifisch für die einzelnen Insektizide sind. Die

beobachteten Veränderungen sind von der gleichen Art wie sie von CHATTORAJ & SHARMA (1965) mitgeteilt wurden. Es wurde beobachtet, daß durch die Anwendung von Aldrin und Nuvan nur geringe haematologische Veränderungen bewirkt werden. Merkliche Veränderungen verursacht die Anwendung von Phosdrin und Endrin, starke haematologische Veränderungen hinterläßt die Verwendung von Sevin und Allethrin.

### Резюме

На взрослых насекомых *Periplaneta americana* (LINNAEUS), нимфх *Poecilotherus pictus* FAVRICIUS и личинках *Prodenia litura* FAVRICIUS изучались гематологические изменения, вызванные применением альдрина, аллетрина, эндрина, нувана, фоздрина и севина. Инсектициды вызывали у насекомых различные типы ненормальностей, которые, однако, не являются характерными для отдельных инсектицидов. Наблюдавшиеся изменения имеют тот же вид, как изменения сообщенные CHATTORAJ & SHARMA (1965). Наблюдалось, что применение альдрина и нувана вызывает только незначительные гематологические изменения. Заметные изменения вызывает применение фоздрина и эндрина, а применение севина и аллетрина оставляет сильные гематологические изменения.

### References

- ARNOLD, J. W., Effects of certain fumigants on haemocytes of the Mediterranean flour moth, *Ephestia kuehniella* ZELL. (Lepidoptera: Pyralididae). Can. Journ. Zool., **30**, 365—374; 1952.
- CHATTORAJ, A. N. & SHARMA, V. P., Changes induced in the blood cells of insects by the application of certain organic insecticides. Beitr. Ent., **15**, 157—166; 1965.
- JONES, J. C. & TAUBER, O. E., Abnormal haemocytes in Mealworms (*Tenebrio molitor* L.). Ann. ent. Soc. Amer., **47**, 428—444; 1954.
- LEPESME, P., L'action externe des arsenicaux sur le Criquet pèlerin (*Schistocerca gregaria* FORSK.). Bull. Soc. Hist. Nat. Afr. Nord, **28**, 88—103; 1937.
- PILAT, M., The effects of intestinal poisoning on the blood of locusts (*Locusta migratoria*). Bull. Ent. Res., **26**, 283—292; 1935.
- TAREEVA, A. I. & NENJUKOV, B. V., Effect of poisons on normal digestion and the blood of *Calliptamus*. [In Russ.]. Bull. Plant Prot. (Leningrad), **3**, 39—49; 1931.
- TOUMANOFF, M. C. & LAPIED, M., Action du dichlophenyltrichloroethane (DDT) sur les chenilles de la fausse teigne des ruches *Galleria mellonella* L. Effet de la temperature. Action sur le sang. Acad. Agr. de France, May 24 p. 4; 1950.
- YEAGER, J. F. & MUNSON, S. C., Changes induced in the blood cells of the Southern Armyworm (*Prodenia eridania*) by the administration of poisons. Journ. Agr. Res., **64**, 307—332; 1942.