EFFECT OF SYNERGISED DIELDRIN AND MALATHION ON F_1 AND RESISTANT STRAINS OF *PERIPLANETA AMERICANA* L.

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3,4-methylenedioxy-6-propylbenzoyl butyldiethylene glycol ether (Piperonyl butoxide) 1,2-methylene dioxy-4-2,(2-(Octylsulfinyl)-propyl)-benzene (sulfoxide) and 2-diethyl aminoethyl 2,2-diphenyl valerate (SKF 525A) synergise dieldrin, a cyclodiene and malathion an organophosphorus compound were tested against the cockroaches, *Periplaneta americana* L., and it was observed that the synergistic effect is higher with resistant strain than with F_1 strain. The synergistic effect of sulfoxide was generally higher in resistant strain than that of piperonyl butoxide and SKF 525A.

The present note is an investigation of the synergistic action of piperonyl butoxide, sulphoxide and SKF 525A when mixed with dieldrin and malathion and applied to F_1 and resistant strain of cockroaches. The need to investigate such a phenomenon was felt to overcome two problems; one, the increased tolerance in the successive generations due to persistent application of pesticides; two, a fall in potency of the applied chemical against the pest species due to their repeated application. The situation can be handled best by the synergism which increases the efficiency of the insecticide.

Periplaneta americana obtained from parent strain and dieldrin and malathion resistant strains cultured in the laboratory for the successive generations at $30 \pm 2°C$ and relative humudity $60 \pm 5\%$. The tests were conducted at the levels of resistance 14.92 and 8.24 fold for dieldrin and malathion respectively. Newly emerged adults, weighing 1.462–1.468 g each were treated topically at 4th abdominal tergite.

Solutions (0.2, 0.4, 0.8 and 1.6%) of technical grade of malathion 98.7% and dieldrin (98.24%) were prepared in acetone. Each insect was treated with 1 μl of acetone solution of the insecticide or insecticide and synergist at the same level of concentrations. Insecticide and synergist were mixed in a ratio of 1:5. The degree of synergism was determined by estimating the factor of synergism (FS). At least 5 replicates of 20 insects each, were used for each concentration, mortality counts were recorded 24 hr after treatment. Data was corrected for natural mortality[1]. The dose mortality curves and LD_{50} values were determined by Probit analysis[2]. The slopes of doses mortality curves were also taken into account to evaluate the nature of response to the insecticide and the insecticide mixed with synergist.

Synergism of considerable level is observed with similar FS values when applied with dieldrin on the F_1 strain. Such an effect is higher in dieldrin resistant strain particularly with sulphoxide which gave an FS value of 6.15. Similar findings were earlier reported by Guirguis *et al.*[3] in *S. littoralis*. However, malathion was antagonized when mixed with the aforesaid synergists and tested on F_1 strain of

Table 1 *Influence of PB, sulphoxide and SKF 525A on the toxicity of dieldrin and malathion against F_1 and resistant strains of P. americana L.*

Treatment	Resistant strain LD_{50}	Resistant strain Slope (b)	Resistant strain Factor of synergism	F_1 strain LD_{50}	F_1 strain Slope (b)	F_1 strain Factor of synergism
RD strain						
Dieldrin	198.48	3.15	–	16.84	3.24	–
PB + dieldrin	64.23	3.08	3.09	5.42	3.16	3.10
SKF 525A + dieldrin	71.64	3.04	2.77	5.37	3.20	3.14
Sulphoxide + dieldrin	32.18	2.94	6.15	4.75	3.67	3.54
RM strain						
Malathion	151.42	4.12	–	19.16	3.94	–
PB + malathion	82.10	3.78	1.84	72.43	3.14	0.26
SKF 525A + malathion	81.74	3.54	1.85	53.46	2.58	0.35
Sulphoxide + malathion	76.02	3.10	2.01	23.17	4.12	0.82

Where factor of synergism (FS) = $\dfrac{LD_{50}\text{ of insecticide alone}}{LD_{50}\text{ of synergised insecticide}}$

Where unity shows an interaction <1 = antagonism; >1 = synergism

P. americana (table 1). It is clear that the synergistic effect of sulphoxide on the toxicity of dieldrin and malathion was higher than that of piperonylbutoxide and SKF 525A, particularly on resistant strain. It becomes evident that sulphoxide has a greater effect on resistant than on F_1 strain, may be due to greater amount of active degrading enzymes in resistant strain[4] which increases the toxicity probably by blocking of aliesterase enzyme. In the resistant strain, an additional particulate carboxylesterase has been observed which shows greater activity than the soluble enzyme. This enzyme is readily inhibited by the malathion and dieldrin. This is in accordance with the findings of Welling and Blaakmeer[5]. The blocking of such enzymes renders the availability of toxicant at the site of action. Similar observation was reported by Bigley[6] and Townsend and Busvine[7] for the blowfly *Chrysomya putoria*. It can be concluded that the pattern of synergism is a mixed phenomena which on the one hand is governed by variation in the enzyme activity of susceptible and resistant strain and on the other by the chemical structure of the compound. A correlation between the structure of synergist and that of the toxicant was earlier documented by Valdestra[8], Wilkinson[9] and Metcalf[10].

Further, the use of synergists with an insecticide as compared to its use alone, is more economical. Making use of one part of an insecticide in turn renders the same stock solution available for many individuals of the same species. This reduces the cost of application of the insecticide. This is in accordance with the views of Roberts *et al.*[11]. The above described correlation explains the long awaited answer why insecticides quickly show the effect when mixed with a synergist as compared to its use without it.

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CONTROL OF TESTES FUNCTION IN BLACKHEADED BUNTING, *EMBERIZA MELANOCEPHALA*

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CONSIDERABLE research work has been carried out during the past two decades to ascertain if photoperiodic birds use their circadian system to measure the photoperiodic time[1-3]. Yet, very little is known about the photoperiodic control systems in species that migrate between Indian subcontinent and south east Asia. However, it was recently demonstrated that the variations in daylength have direct effect on gonadal function in the black headed buntings (*Emberiza melanocephala*), an emberizid finch, which overwinters at Varanasi (India; 25°18′N, 83°01′E)[4]. Exposure of buntings to day lengths less than 12 hr causes gonadal regression and cessation of gonadal functions, while longer photoperiods induce growth and development of the testes[5]. The testicular response to day length in this species is mediated by circadian photoperiodic time measurement[6], similar to that of other birds[1,2]. The present study is aimed further to determine whether the gonadotropic hormone secretion induced by long days in buntings is dependent on the photoinducible phase.

Acclimatised male blackheaded buntings were kept on short day lengths (8L:16D) for eight weeks in the fall (combined testicular weight, CTW = ca. 5 mg). Groups of photosensitive birds were then exposed to interrupted-dark cycles, in which 1 hr light pulses (1 L) were introduced during scotophase of a 6L:18D cycle. Time of 'light-interruption' was changed from group to group to reveal the photosensitive phase, *i.e.* 6L:4D:1L:13D (Group G_{10}), 6L:6D:1L:11D