Relation between Injected Dose of
Dichlorvos and Carbaryl and Lethal
Time against Developing Larvae of
Mamestra brassicae L. (Lepidoptera:
Noctuidae)¹

Kimihiko SATO

Faculty of Agriculture, Tokyo University of Agriculture
and Technology, Fuchu, Tokyo 183, Japan

(Received July 30, 1987)

Insecticidal action soon killed a lepidopterous larva when a certain dose of the insecticide was applied topically. The products of $(W - W_0)$ and $(T - T_0)$, K , resulting in an approximately constant value using Eq. (1),

$$(W - W_0)(T - T_0) = K \quad (1)$$

where W represents the applied dose of insecticide, W_0 the minimum amount causing larval death, T the lethal time (time between insecticide application and larval death, and T_0 the minimum lethal time of a larva. The value of K for an insecticide increased in parallel with larval development (SATO and SUWANAI, 1976). Also, the same relation was obtained when dichlorvos or carbaryl was injected into developing larvae of *Spodoptera litura* (SATO, 1985).

Experiments on the relation between an injected dose of dichlorvos or carbaryl against developing larvae of *Mamestra brassicae* were performed in the laboratory. Five–seven larvae of *M. brassicae* (fresh weight: 155–990 mg) reared aseptically on an artificial diet (HATTORI and ATSUSAWA, 1980) under laboratory conditions (25°C, 16L–8D). They were injected through the anus with 0.2–5 μ l of acetone–water solution containing 1, 10 and 100 μ g/ μ l dichlorvos (purity: 99.3%) or carbaryl (purity: 95.9%) provided by Hokko Chemical Industry Co., Ltd., Tokyo, Japan. A microsyringe MS-10 (Terumo Co., Ltd., Tokyo, Japan) was used for the injections. Three or four replicates were made at $25 \pm 1^\circ\text{C}$. Injected larvae were kept individually in 9 cm petri dishes and toxic symptoms were observed carefully.

A larva not responding to pencil tip prodding was considered dead, and the time was recorded as the lethal time caused by an injected dose (W) of

an insecticide. Relation between W of dichlorvos or carbaryl injected into developing larvae of *M. brassicae* and the mean lethal time (T) are shown in Figs. 1 and 2. Values of W were plotted against T on logarithmic graph paper and each curve resulted in a clear hyperbola. On a single hyperbola, the value of T tends to a limit of T_0 (leftmost point of each hyperbola) with the increase in the value of

Fig. 1. Relation between the injected dose of dichlorvos and the lethal time against developing larvae of *Mamestra brassicae*. Larval weight, ●: 160 ± 5 , ○: 340 ± 8 , ▲: 530 ± 15 and △: 930 ± 20 mg.

Fig. 2. Relation between the injected dose of carbaryl and the lethal time against developing larvae of *Mamestra brassicae*. Larval weight, ●: 160 ± 5 , ○: 340 ± 8 , ▲: 760 ± 18 and △: 970 ± 20 mg.

¹ Appl. Ent. Zool. 23 (1): 107–108 (1988)

Table 1. Values of W_0 , T_0 and K in Eq. (1)^a for dichlorvos and carbaryl against developing larvae of *Mamestra brassicae*

Insecticide	Larvae		Minimum injected dose, W_0 , μg	Minimum lethal time, T_0 , hr	K , $\mu\text{g}\cdot\text{hr}$
	Instar	Fresh weight, M , mg			Mean $\pm$ S.D.
Dichlorvos	5	160 $\pm$ 5	0.4	0.04	0.388 $\pm$ 0.036
	6	340 $\pm$ 8	0.7	0.05	0.829 $\pm$ 0.087
	6	530 $\pm$ 15	1.2	0.08	1.298 $\pm$ 0.155
	6	930 $\pm$ 20	1.8	0.09	2.205 $\pm$ 0.204
Carbaryl	5	160 $\pm$ 5	1.5	0.08	1.92 $\pm$ 0.06
	6	340 $\pm$ 8	2.0	0.15	4.03 $\pm$ 0.21
	6	760 $\pm$ 18	5.0	0.30	9.11 $\pm$ 0.34
	6	970 $\pm$ 20	8.0	0.50	11.42 $\pm$ 1.47

$$^a (W - W_0) (T - T_0) = K \quad (1)$$

W , while the value of W tends to a limit of W_0 (rightmost point of each hyperbola) with the increase in the value of T . The calculated products of $(W - W_0)$ and $(T - T_0)$ revealed an approximately constant value as given in Eq. (1). Values of W_0 , T_0 and K are shown in Table 1.

The value of K increased in parallel with the development of the larvae. So, an equation on the relation between K and the weight of a larva (M) was obtained as follows,

$$K = aM + B \quad (2)$$

where a is determined by the combination of the insecticide and a larva. Expressing K in $\mu\text{g}\cdot\text{hr}$ and M in mg within Eq. (2) using the data in Table 1, the value of a for dichlorvos and carbaryl is 0.0024 and 0.012, and B is 0, respectively.

These relations were the same as topical toxicities of insecticides against developing lepidopterous larvae: on *M. brassicae* values of a for dichlorvos and carbaryl were 0.10 and 2.1, respectively (SATO and SUWANAI, 1976), about 42 and 175 times greater

than with the injection. The smaller the value of a is, the more toxic is the insecticide to an insect larva; therefore, injection is proved more effective than topical application.

Equations (1) and (2) are very useful in evaluating the potency of an insecticide against an insect (SATO, 1985). a value in Eq. (2) would depend on the increase in the concentration of an insecticide to cause 50% inhibition of acetylcholinesterase from developing larvae of *M. brassicae* and *S. litura* with their fresh weight (SATO and KUSANO, 1988).

REFERENCES

- HATTORI, M. and S. ATSUSAWA (1980) *Jap. J. appl. Ent. Zool.* **24**: 36-38 (in Japanese with an English summary).
 SATO, K. (1985) *Appl. Ent. Zool.* **20**: 232-234.
 SATO, K. and T. KUSANO (1988) *Appl. Ent. Zool.* **23**: 105-106.
 SATO, K. and M. SUWANAI (1976) *Botyu-Kagaku* **41**: 112-134 (in Japanese with an English summary).