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ACTION OF TEDION ON EGGS AND OVARIES OF SPIDERMITES[1])[2])

Met een samenvatting: Werking van tedion op eieren en ovariën van spintmijten

BY

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INTRODUCTION

EATON & DAVIES (1950) found that chlorine substitution in one benzene nucleus of diphenyl sulphone in the para position is associated with maximum acaricidal activity. Diparachlorodiphenyl sulphone shows considerably less activity. Therefore we were surprised to find that 2,4,5,4'-tetrachloro-diphenyl sulphone (tedion) possesses an extremely high ovicidal and larvicidal activity on tetranychid mites as compared with diphenyl sulphone and mono-p-chloro-diphenyl sulphone (table 1).

TABLE 1. Ovicidal and larvicidal action of mono-p-chlorodiphenyl sulphone and tedion (2,4,5,4'-tetrachloro-diphenyl sulphone).
E = percentage of killed eggs; L = percentage of killed larvae and nymphs; T = total mortality percentage.

TABEL 1. *Ovicide en larvicide werkzaamheid van mono-p-chloordifenyl sulfon en tedion (2,4,5,4'tetrachloordifenyl sulfon).*
E = percentage gedode eieren; L = percentage gedode larven en nymfen; T = totaal sterfte-percentage.

Compound *Verbinding*	Conc. p.p.m.	Dipped eggs *Gedompelde eieren*			Eggs laid on dry deposit *Eieren, gelegd op droog residu*		
		E	L	T	E	L	T
mono-p-chlorodiphenyl sulphone	1000	24	89	92	9	3	12
	300	7	13	19	3	0	3
	100	4	0	4	3	0	3
tedion	100	93	100	100	100	–	100
	30	90	100	100	99	100	100
	10	81	99	99	98	100	100
	3	40	93	96	95	100	100
	1	8	90	91	68	56	86

Field tests and experiences of many practioners have shown that tedion is an effective acaricide on fruits, hops and other crops. The results of field trials in 1954 and 1955 were reported by FLIK (1957) at the International Horticultural Congress at Scheveningen in 1955.

As can be seen in table 1, the eggs which were laid on the dry deposit, seem to be more susceptible than the ones which were directly dipped into the

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emulsions. The reason for this different response might be that the age of the eggs influences the susceptibility. Another possibility is that the developing eggs in the ovary are already affected by tedion, which is taken up by the female in spite of the fact that the adult females do not show any symptom of intoxication. Both possibilities are examined in the experiments described in this paper.

METHODS

Most experiments have been carried out with eggs of *Tetranychus urticae* KOCH on potted dwarf beans (*Phaseolus vulgaris* L.) at the stage with one pair of normal leaves. A number of tests has been done with summer eggs of *Metatetranychus ulmi* KOCH on potted apple seedlings of about 5″ height.

Plants with and without eggs were dipped into emulsions or suspensions of the substances concerned in water. After dipping, the plants without eggs were infected with adult females, in order to obtain eggs on the dry deposit. The females were kept at one spot of the leaf by using plastic cages of about 1″ diameter and 0.5″ height. The plants which were dipped with eggs, had been treated in a similar manner before dipping.

Generally the adult females and the plastic cages were removed after two to three days, except when the possible influence of the age of the eggs was studied. Mortality was noted eight to ten days after removal of the females. The mortality percentages performed in the tables are computed by using ABBOTT's formula $\frac{a-b}{a} \times 100\,\%$, whereby a represents the number of survivors of the control and b the survivors of the object concerned. Control mortality in this type of test is very low; as a rule less than 3 %, rarely more than 5 %, and never more than 10 %.

ACTION OF TEDION ON EGGS OF DIFFERENT AGES

The effectiveness of tedion on eggs of different ages has been examined in some special tests. In these tests females of *Tetranychus urticae* KOCH were allowed to lay eggs on untreated bean leaves during five hours. After that time the adults and the plastic cages were removed. One batch of bean plants was then dipped immediately; the remaining batches were dipped after one, two, three and four days respectively. The eggs which aged four days were partially hatching at the moment of dipping.

As can be seen from table 2, the susceptibility of the eggs of nought to three days is not clearly different. The low egg mortality of the four-day eggs is certainly caused by the fact, that these were already hatching at the moment of dipping. The following observations have been made:

a. eggs of nought to two days. As far as hatching occurred, postembryonic mortality at all concentrations took place before the nymphochrysalis stage.

b. eggs of three days. With the highest concentrations all larvae died. Some of the eggs treated with 3 or 1 ppm tedion were able to develop into nymphochrysalis or protonymph before dying.

c. eggs of four days. As the eggs were hatching at the moment of dipping, egg mortality has been low. At the highest concentration all larvae died. With the

TABLE 2. Effectiveness of tedion on eggs of *Tetranychus urticae* of different ages. E = percentage of killed eggs; T = total mortality percentage.

TABEL 2. *Werkzaamheid van tedion op eieren van* Tetranychus urticae *van verschillende leeftijd. E = percentage gedode eieren; T = totaal sterftepercentage.*

Age of eggs (days) *Leeftijd van de eieren (dagen)*	0		1		2		3		4	
conc. (ppm.)	E	T	E	T	E	T	E	T	E	T
100	100	100	92	100	99	100	99	100	57	100
30	100	100	94	100	92	100	99	100	54	100
10	100	100	90	100	96	100	98	100	42	100
3	100	100	87	100	79	100	80	100	17	100
1	82	96	8	100	63	100	20	100	12	99

lower concentrations the moment of death was gradually delayed to following stages, and at the lowest concentration (1 ppm) mortality occurred chiefly in the deutochrysalis stage.

In other tests we only compared the ages of nought and three days by using the concentrations of 30, 3 and 0.3 ppm of tedion. In these tests the mortality rate was lower than in the previous one. Dead and living mites of each stage were counted separately. Table 3 and fig. 1 show that death occurred chiefly between egg stage and nymphochrysalis. At the concentrations of 3 and 0.3 ppm, however, some mortality is delayed till the protonymph, deutochrysalis, and even deutonymph stage.

The results at the lowest concentration of these tests suggest that the three day old eggs are slightly more susceptible than those of nought day. This is

TABLE 3. Distribution of mortality with respect to stages, after treatment of eggs of *Tetranychus urticae* with tedion. Mean mortality percentages of two experiments. E = egg; L = larvae; NC = nymphochrysalis; PN = protonymph; DC = deutochrysalis; DN = deutonymph; TC = telochrysalis; IM = imago.

TABEL 3. *Verdeling van de sterfte over de ontwikkelingsstadia na behandeling van de eieren van* Tetranychus urticae *met tedion. Gemiddelde sterftepercentages van twee proeven. E = ei; L = larve; NC = nymfochrysalis; PN = protonymf; DC = deutochrysalis; DN = deutonymf; TC = telochrysalis; IM = imago.*

Age of eggs at moment of treatment *Leeftijd der eieren op het tijdstip van behandeling*	Conc. ppm	E	L	NC	PN	DC	DN	TC	IM	Total mort. percentage *Totaal sterftepercentage*
0 day *0 dagen*	30	93	4	1	0	0	0	0	0	98
	3	64	7	24	3	0	0	0	0	98
	0.3	10	1	12	1	1	3	0	0	28
3 days *3 dagen*	30	95	4	1	0	0	0	0	0	100
	3	72	15	11	1	0	0	0	0	99
	0.3	10	16	36	3	2	1	0	0	68

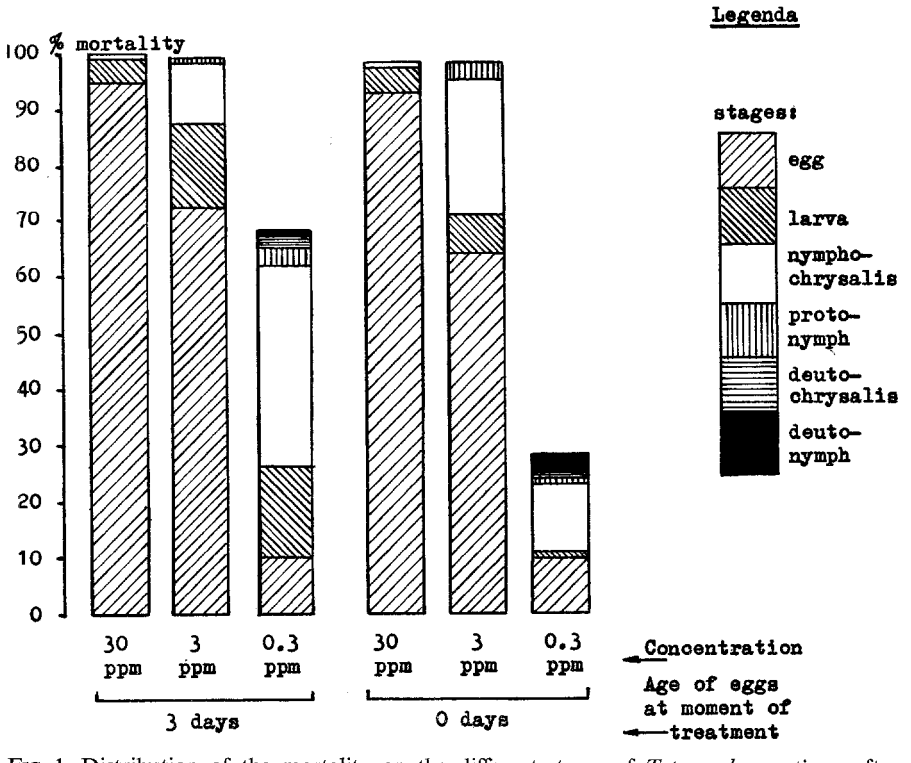

FIG. 1. Distribution of the mortality on the different stages of *Tetranychus urticae*, after treatment of the eggs with tedion.

FIG. 1. *Verdeling van de sterfte over de verschillende ontwikkelingsstadia van* Tetranychus urticae *na behandeling van de eieren met tedion.*

certainly not so, for with the extremely low concentration of 0.3 ppm the decomposition of tedion by physiologic processes of the leaf interferes, so that for the hatching larvae of the latter group there is less tedion available than for the larvae of the first group. This matter will be discussed in a later paper. In the former test (table 2) with 1 ppm as the lowest concentration this effect does not occur.

ACTION OF TEDION ON THE OVARIES OF SPIDERMITES

In a previous paper (MELTZER, 1956) it has been shown, that eggs from females of *Tetranychus urticae* KOCH, which had been exposed to tedion prior to oviposition do not hatch on untreated plants. The females in these experiments remained first three days on plants which had been treated with tedion. After that period they were transferred to untreated plants. The eggs laid by these females during another five days appeared to be sterile. From that time on a number of viable eggs occurred and this number increased day by day. After eight days the influence of tedion on the ovary was practically lost. Also CPBS[1])

[1]) p-chlorophenyl benzene sulphonate

TABLE 4. Mortality of eggs of *Tetranychus urticae* on untreated bean leaves, laid by females which remained previously three days on treated bean plants. E = percentage of killed eggs; T = total mortality percentage.

TABEL 4. *Sterfte van eieren van* Tetranychus urticae *op onbehandelde bonebladeren, gelegd door wijfjes, welke daarvoor drie dagen op behandelde planten verbleven. E = percentage gedode eieren; T = totaal sterfte percentage.*

	On treated leaves *op behandelde bladeren*		Number of days between transfer to untreated plants and oviposition *Aantal dagen tussen overbrenging op onbehandelde planten en eiafzetting*													
			0–1		1–2		2–4		4–5		5–6		6–8		8–9	
	E	T	E	T	E	T	E	T	E	T	E	T	E	T	E	T
CPBS																
1000 ppm	95	100	54	74	15	55	11	20								
100 ppm	90	100	14	51	18	60	11	19								
chlorbenside																
1000 ppm	100	100	36	40	8	12	7	14								
100 ppm	99	100	52	66	2	16	0	1								
tedion																
1000 ppm	100	100	100	100	100	100	100	100	100	100	91	96	49	55	9	19
100 ppm	100	100	100	100	100	100	100	100	86	90	62	65	16	21	3	11

and chlorbenside[1]) show a similar action on the ovary, but the effect is considerably less lasting than with tedion. A survey of the results of one of the tests is given in table 4.

This effect is also obtained, if the females are exposed to the underside of leaves, which are treated at the upperside only (MELTZER, 1956). Hence the

TABLE 5. Mortality of summer eggs of *Metatetranychus ulmi* on untreated apple leaves, laid by females which remained previously three days on treated apple seedlings. Mean mortality percentage of two experiments. E = percentage of killed eggs; T = total mortality percentage.

TABEL 5. *Sterfte van zomereieren van* Metatetranychus ulmi *op onbehandelde appelbladeren, gelegd door wijfjes, welke vooraf drie dagen op behandelde appelzaailingen verbleven. Gemiddelde sterftepercentages van twee proeven. E = percentage gedode eieren; T = totaal sterftepercentage.*

Compound *verbinding*	Concentr. (p.p.m.)	Eggs laid on treated leaves *Eieren gelegd op behandelde bladeren*		Number of days between transfer to untreated plants and oviposition *Aantal dagen tussen overbrenging op onbehandelde planten en eiafzetting*			
				0–2		2–4	
		E	T	E	T	E	T
tedion	300	99	100	100	100	38	39
	100	98	100	99	99	12	12
	30	97	100	82	82	3	3
CPBS	300	97	100	52	63	2	2
	100	72	85	38	46	3	4
	30	63	84	5	9	1	1
chlorbenside	300	100	100	92	93	20	20
	100	100	100	91	92	10	10
	30	100	100	64	67	3	3

[1]) p-chlorophenyl-p-chlorobenzyl sulphide

kill of the eggs is not caused by contact of the females, but must be obtained by the oral uptake.

VAN DE VRIE (1956), working with females of the fruit tree red spider, found that tedion and chlorbenside both affected the developing eggs in the ovary. In his trials the females were left 48 hours in contact with treated leaves and after that transferred each 48 hours to fresh untreated leaves. After three to four times 48 hours the action of chlorbenside on the newly laid eggs could be observed, whereas the action of tedion appeared to be lost after two times 48 hours. As to VAN DE VRIE (1957) the interpretation of his experiments by CRANHAM (1956) is not correct.

The results of our experiments with females of the fruit tree red spider, *Metatetranychus ulmi* KOCH, are not fully in agreement with those of VAN DE VRIE. In the same manner as with *Tetranychus*, the developing eggs in the ovary are affected by tedion. However, the effect is far less lasting than in *Tetranychus*. Whether this is caused by differences in the mite species or by differences in the host plants used is not known. Perhaps a longer-lasting effect may be obtained by allowing the mites to feed some days longer on the treated plants. Nevertheless it is obvious that the action of CPBS on the ovary is considerably less than of the other substances, whereas tedion appears to be slightly more effective than chlorbenside (table 5).

SUMMARY

1. Eggs of *Tetranychus urticae* KOCH of nought to four days of age do not differ in susceptibility to tedion.
2. The moment of kill after treatment with tedion is not restricted to a special stage of development. However, most kill occurs between egg stage and nymphochrysalis.
3. Tedion affects developing eggs in the ovary of *Tetranychus urticae* KOCH after the females have taken up tedion orally. This effect lasts for at least five days after transfer of the females to untreated plants. With CPBS and chlorbenside no complete kill is obtained in this manner, even less than a day after transfer to untreated plants.
4. Tedion affects also the developing eggs in the ovary of *Metatetranychus ulmi* KOCH. However, in this species the killing effect is lost within two to four days after transfer of the females to untreated plants. Chlorbenside acts slightly less in this manner, whereas CPBS is far less active.

SAMENVATTING

Er worden meer eieren van spintmijten gedood, indien zij op het droge residu van tedion op bladeren worden afgezet, dan wanneer zij direct in de tedion-emulsie worden gedompeld (tabel 1). Een verklaring zou kunnen zijn, dat jonge eieren gevoeliger zijn dan oudere. Een andere verklaring zou kunnen zijn, dat de eieren in het ovarium reeds aangetast worden door tedion, dat door het wijfje uit het behandelde blad is opgenomen. Beide mogelijkheden zijn in de hier beschreven proeven onderzocht.

De meeste proeven werden uitgevoerd met eieren van bonespint, *Tetranychus urticae* KOCH, op stambonen in potjes. Een aantal proeven werd verricht met

zomereieren van fruitspint, *Metatetranychus ulmi* KOCH, op appelzaailingen van ongeveer 12 cm hoogte. De details van de dompelproeven werden reeds eerder uitvoerig beschreven (MELTZER, 1955).

Wanneer eieren van nul, een, twee, drie en vier dagen oud werden gedompeld in een tedion-emulsie bleek geen betrouwbaar verschil in de totale doding te bestaan (tabel 2). Wel bleek, dat het tijdstip van sterfte bij de eieren van vier dagen naar latere stadia was verschoven, hoofdzakelijk door het feit, dat tijdens de behandeling reeds een gedeelte der eieren was uitgekomen. Ook werd het tijdstip van sterfte naar een later stadium verschoven, naarmate een lagere concentratie werd toegepast. Een bepaald ontwikkelingsstadium bleek dus niet critiek te zijn voor het optreden van de sterfte, al trad deze in hoofdzaak op tussen eistadium en nymfochrysalis (tabel 3 en fig. 1).

Wanneer spintwijfjes enkele dagen hebben doorgebracht op boneplanten, welke met tedion zijn behandeld, en vervolgens worden overgebracht op onbehandelde planten, worden normaal eieren afgezet. De eieren, welke nu gedurende de eerste vijf dagen op de onbehandelde planten worden afgezet blijken evenwel steriel te zijn. Daarna verschijnt een toenemend aantal levensvatbare eieren, totdat na acht dagen het effect van tedion op het ovarium practisch is opgeheven. Ook met CPBS en chlorbenside is een dergelijk effect aantoonbaar, maar deze stoffen veroorzaken op deze wijze geen totale sterfte, ook niet één dag na het overbrengen op onbehandelde planten (zie tabel 4).

Aangezien deze werking van tedion op het ovarium ook wordt verkregen, indien men de wijfjes brengt op de onderzijde van bladeren, welke alleen aan de bovenzijde zijn behandeld, wordt het effect niet veroorzaakt door contact van het wijfje met tedion, maar moet het toegeschreven worden aan de orale opname uit het blad.

Soortgelijke proeven, uitgevoerd met wijfjes van het fruitspint op appelblad tonen aan, dat tedion ook bij deze soort werkt op de zich in het ovarium ontwikkelende eieren. Het effect houdt echter niet zolang aan als bij bonespint (tabel 5). Of dit verschil wordt veroorzaakt door verschillen in de spintsoorten of door verschillen in de waardplanten is niet bekend. Chloorbenside is slechts iets minder en CPBS veel minder via het ovarium werkzaam.

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