原　著

Effects of Chemosterilants on the Development and Fertility of the Housefly, *Musca domestica nebulo* Fabr. Musharraf A. Ansari (Zoology Department, Aligarh Muslim University, Aligarh, India.) Received August 23, 1972. *Botyu-Kagaku*, 38, 1, 1973.

1. 不妊剤のイエバエの発育と生殖に及ぼす影響について

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Apholate, tepa, metepa, hempa 及び hemel のイエバエの発育と生殖に及ぼす影響を調べた．これらの薬剤のエタノール溶液に4日目の幼虫を浸漬して効力を調べた．1%溶液に短時間浸漬しただけで発育が妨げられ，高い致死率を示した．また，蛹化したものでも成虫にはならなかった．高濃度で成虫になるものもあったが，産卵は妨げられ，全く産卵しなかった．しかし，興味あることは，高濃度でも100%の不妊化率は得られなかったことである．

That certain chemicals may adversely effect the growth and development of an insect has been reported by a number of workers. Mitlin *et al.* (1954, 1957), Konecky and Mitlin (1955), Mitlin (1956) and Mitlin and Baroody (1958a, 1958b) found that mitotic poisons, antimetabolites and thiourea when administered in the food of adults or in the larval medium were able to inhibit ovarian development in the housefly, *M. d. domestica*. Later Labrecque *et al.* (1960) elaborated the work of Mitlin and reported that of the two hundred compounds tested for their ability to sterilize or otherwise interfere with the normal development of *M. d. domestica*, seventy nine showed deleterious effects when added in the larval medium but only ten of them were harmful when added to the food of the adults. Gouck and Labrecque (1963) further eleven hundred and sixty compounds in the larval medium and observed that two hundred forty five of them were larvicide at 0.5gm but not at 0.1gm while one of them, ENT-50115 (dimethane sulfonate of 1, 4-bis (3-hydroxypropionyl) piperazine, retarded oviposition and induced sterility in flies at doses low enough to permit adult emergence. The chemical 2-imidazolidinane, also inhibited the growth and development of larvae when introduced in the larval medium (Simkover, 1964). Similar results were obtained by Schaefer and Tieman (1967) when the eggs of *M. d. domestica* were placed in alarval medium containing 50-500 parts of 4-imidazoline-2-one per million. Hafez *et al.* (1969) treated the larvae of *M. d. vicina* with apholate, tepa, metepa and found that all these chemicals acted as larvicide and pupicide. A 58.9 percent net sterility was obtained by Raghuwanshi *et al.* (1968) when the larvae of *M. d. nebulo* were dipped in 1.0 percent solution of apholate in ethanol.

Materials and Methods

The present author studied the effects of apholate, tepa, metepa, hempa and hemel on the develoment and fertility of the Indian housefly, *M. d. nebulo* by obtaining four day old larvae from normal laboratory stock and dipping them in the desired concentrations of chemosterilant solutions in ethanol for 30, 60, 120 and 240 seconds. Hundred larvae were used in each test. The treated larvae were allowed to dry on a blotting paper before being transferred to glass jars containing the rearing medium. On the third day of each treatment, the pupae were removed, counted and placed in small petri dishes. On emergence the flies were kept in cloth cages and were fed on cotton pads soaked in milk. Larvae dipped in ethanol solution were used as check. A random sample of 100 eggs was collected and the rate of hatching was determined on black moist cloth at interval of 24 hours and percent net sterility was calculated.

Results

It seems that apholate, tepa, metepa, hempa and hemel can all be used as larvicides and pupicides (Tables 1-5). Solutions of 4.0, 2.0 and

Table 1. Percentage pupation and rate of emergence of flies obtained on dipping the larvae in ethanol solutions of apholate.

Concentration (%)	Time in seconds							
	30		60		120		240	
	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged
0.0078	95*	60	96	62	92	51	91	41
0.0156	98	56	96	59	95	46	91	39
0.03125	96	55	95	53	95	48	90	36
0.0625	96	31	95	26	93	23	92	19
0.125	96	24	92	19	89	15	87	9
0.25	90	15	91	7	88	5	82	8
0.5	90	2	89	1	88	0	78	0
1.0	88	2	80	0	72	0	62	0
2.0	62	0	60	0	43	0	35	0
4.0	56	0	36	0	35	0	28	0
Control	98	81	94	76	96	78	97	69

* 100 larvae were used in each test.

Table 2. Percentage pupation and rate of emergence of flies obtained on dipping the larvae in ethanol solutions of tepa.

Concentration (%)	Time in seconds							
	30		60		120		240	
	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged
0.0039	97*	63	96	55	96	49	93	41
0.0078	97	59	96	58	95	48	93	39
0.0156	96	51	95	50	95	42	92	28
0.03125	96	49	95	41	94	39	92	17
0.0625	96	5	95	2	91	0	89	0
0.125	94	2	91	1	89	0	86	0
0.25	96	0	92	0	89	0	91	0
0.5	54	1	34	0	52	0	36	0
1.0	71	0	65	0	58	0	50	0
2.0	49	0	11	0	12	0	9	0
4.0	30	0	23	0	29	0	17	0
Control	98	81	94	76	96	78	97	69

* 100 larvae were used each test.

1.0 percent apholate, tepa and metepa in ethanol adversely affected the development of the flies. Even the larvae which pupated failed to become adults when dipped in 1.0 percent solution of these chemicals for 30, 60, 120 and 240 seconds. Again no emergence could be obtained in pupae from the larvae which had been treated with 4.0 percent of hempa for 120 to 240 seconds. However, no such inhibition of development could be obtained with hemel even at 4.0 percent. None of the chemosterilant tested produced 100.0 percent mortality of the larvae. This is in contrast to the findings of Hafez *et al.* (1969) who observed 100.0 percent mortality when 200mg of apholate, 500mg of metepa, 100mg of hempa or 500mg of tepa per 50gm of food was introduced in the rearing medium of the larvae. It is possible that the larvae may consume more

Table 3. Percentage pupation and rate of emergence of flies obtained on dipping the larvae in ethanol solutions of metepa.

Concentration (%)	Time in seconds							
	30		60		120		240	
	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged
0.0078	97*	59	96	56	94	50	91	46
0.0156	97	55	96	52	94	48	92	39
0.03125	96	51	95	49	93	46	92	42
0.0625	96	31	92	21	90	13	88	6
0.125	94	19	92	13	93	9	90	4
0.25	95	16	92	7	90	0	88	0
0.5	92	2	89	2	82	0	70	0
1.0	88	0	72	0	62	0	59	0
2.0	62	0	58	0	41	0	36	0
4.0	50	0	30	0	20	0	21	0
Control	98	81	94	76	96	78	97	69

* 100 larvae were used in each test.

Table 4. Percentage pupation and rate of emergence of flies obtained on dipping the larvae in ethanol solutions of hempa.

Concentration (%)	Time in seconds							
	30		60		120		240	
	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged
0.125	98*	57	96	46	95	44	92	41
0.25	95	52	94	40	92	39	90	36
0.5	94	49	93	37	91	34	90	30
1.0	95	39	93	36	92	35	85	6
2.0	92	9	93	7	90	5	88	3
4.0	95	2	92	1	89	0	70	0
Control	98	81	94	76	96	78	97	69

* 100 larvae were used in each test.

Table 5. Percentage pupation and rate of emergence of flies obtained on dipping the larvae in ethanol solutions of hemel.

Concentration (%)	Time in seconds							
	30		60		120		240	
	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged	No. pupated	No. of flies emerged
0.25	98*	65	94	59	95	56	93	52
0.5	97	60	96	56	93	55	93	51
1.0	96	55	95	53	91	51	92	48
2.0	96	49	93	45	92	43	90	39
4.0	95	29	93	25	90	8	89	6
Control	98	81	94	76	96	78	97	69

* 100 larvae were used in each test.

chemical when it is given in food so that higher percentage of them is killed. Such somatic damage caused by chemosterilants have already been explained by Lachance *et al.* (1968) who states that the larval forms contain many dividing cells and hence they are often more sensitive to somatic damage by the chemosterilants.

Oviposition was totally retarded in flies obtained from larvae treated with apholate, tepa, metepa and hempa at higher concentrations but no inhibition of oviposition was observed in flies obtained from larvae that were treated with 4.0 percent hemel (Table 6). It is interesting to note that 100.0 percent net sterility was not achieved in any test with all the five chemosterilants. 83.7, 93.9 and 70.3 percent net sterility was obtained when the larvae were dipped for 240 seconds in 0.03125 percent solutions of apholate, tepa and metepa respectively and 91.5 percent net sterility was obtained in tests with 1.0 percent solutions of hempa. Similarly hemel produced 92.1 percent net sterility when the larvae were dipped in 4.0 percent solution of this chemical for 240 seconds. Raghuwanshi and his associates (1968) observed 58.9 percent net sterility without any mortality in four day old larvae of *M. d. nebulo* when dipped in 1.0 percent apholate solution. The present author, however, could not observe any emergence of flies as the development was totally retarded when the larvae were treated with same concentration of apholate.

At lower concentrations which were not lethal to the larvae, very low sterility was observed. This might be due to the fact that such concentrations do not cause sufficient damage in the gonial cells to produce aspermic males as pointed out by Lachance *et al.* (1968) with the result that surviving cells continue to divide and to repopulate the germarium region of the testes with a store of relatively undamaged cells which can

Table 6. Percent net sterility of flies obtained from larvae dipped in ethanol solution of chemosterilants.

Chemosterilant	Time in seconds	Concentration in percent										
		0.0039	0.0078	0.0156	0.03125	0.0625	0.125	0.25	0.5	1.0	2.0	4.0
Apholate	30	—	5.7	18.8	95.2	**	**	**	—	—	—	—
	60	—	7.7	25.9	62.1	**	**	**	—	—	—	—
	120	—	19.1	43.03	70.1	**	**	**	—	—	—	—
	240	—	25.9	52.4	83.7	**	**	**	—	—	—	—
Tepa	30	9.5	35.6	48.07	72.7	**	**	**	—	—	—	—
	60	2.2	40.8	52.8	73.08	**	**	**	—	—	—	—
	120	11.5	45.7	58.3	84.9	**	**	**	—	—	—	—
	240	13.7	41.9	60.5	93.9	**	**	**	—	—	—	—
Metepa	30	—	—	14.1	32.7	70.8	**	**	—	—	—	—
	60	—	6.2	23.3	33.4	88.06	**	**	—	—	—	—
	120	—	8.3	31.4	36.01	90.2	**	**	—	—	—	—
	240	—	7.2	34.4	70.3	**	**	**	—	—	—	—
Hempa	30	—	—	—	—	—	12.0	37.6	50.2	76.4	**	**
	60	—	—	—	—	—	22.04	34.02	75.09	88.4	**	**
	120	—	—	—	—	—	21.4	50.06	60.7	91.5	**	**
	240	—	—	—	—	—	35.6	56.3	78.5	**	**	**
Hemel	30	—	—	—	—	—	—	2.8	9.7	20.1	43.3	61.05
	60	—	—	—	—	—	—	4.4	23.2	25.03	47.7	71.5
	120	—	—	—	—	—	—	8.9	35.5	33.4	59.7	75.9
	240	—	—	—	—	—	—	10.3	37.7	49.4	66.1	92.1

Percent sterility of control flies was 22.2, 22.9, 21.7 and 23.7 respectively at 30, 60, 120 and 240 seconds in ethanol.

** The females did not oviposit.

then produced through meiosis and maturation to yield mature sperms without dominant lethal mutation.

Summary

Effects of apholate, tepa, metepa, hempa and hemel on the development and fertility of *M. d. nebulo* were studied by dipping the four day old larvae in ethanol solutions of these chemicals for different periods of time. It was found that higher concentrations of apholate, tepa, metepa, hempa and hemel totally retarded the development by producing high degree of mortality. Even the larvae which pupated failed to produce adult flies. Oviposition was prevented in flies treated with apholate, tepa, metepa and hempa at higher concentrations which permitted some adult emergence. It was very interesting that 100.0 percent net sterility was not achieved in any test with all the five chemosterilants. At lower concentrations very low sterility was observed.

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抄　　録

ヤガの1種 *Spodoptera littoralis* Boisduval におよぼすジベレリンと β-シトステロールの不妊化作用

Giberellic Acid and β-Sitosterol as Sterilants of the Cotton Leaf worm *Spodoptera littoralis* Boisduval. H. S. Salama and A. M. El-Sharaby, *Experientia*, 28, 413 (1972).

ジベレリンと β-シトステロールの昆虫の成長におよぼす影響について実験を行なった.

半人工飼料でヤガの1種*Spodoptera littoralis* Boisduval を飼育し, テストする物質0.1％を入れて同じように飼育して, 幼虫, 蛹の発育, 蛹の重さ, 羽化率を測定し比較した. さらに得られた成虫30対を容器に入れて, 産卵, 孵化率をしらべた. その結果, コントロールと比べて, 次のような変化が生ずることがわかった.

1. 幼虫期が長くなる.
2. 蛹の重さは, シトステロール添加で減少する.
   コントロール
   ♂ 241.0±13.3mg　♀ 267.1±13.2mg
   シトステロール添加
   ♂ 196.6±9.11mg　♀ 209.8±8.27mg
3. ジベレリン添加で飼育した成虫の産卵は減少する.
4. 孵化率は, ジベレリン, シトステロール添加共に減少する.

コントロール	99.4%
シベレリン添加	1.4%
シトステロール添加	8.5%

(高橋正三)