原　著

Effects of Apholate on the Bionomics of *Musca domestica nebulo* Fabr. Om Prakash Raghuwanshi, Islam Ahmad and Nawab H. Khan (Department of Zoology, Muslim University, Aligarh, India.) Received September 11, 1968. *Botyu-Kagaku*, 33, 119, 1968.

15. イエバエ *Musca domestica nebulo* Fabr. の生態に及ぼす apholate の作用.

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Apholate をイエバエ *Musca domestica nebulo* の幼虫，蛹，成虫に施用し，成虫の寿命，産卵，ふ化を調べた．最も有効な施用法は成虫に摂食させる方法で成虫の餌に apholate を 0.025％含めた砂糖液を与えると，100％不妊化する．成虫あるいは幼虫および成虫の両期に処理すると，産卵前および産卵後期間を延長するが，産卵期間は著しく短縮される．apholate 処理により成虫の寿命は短くなる．また産卵した雌は，産卵しなかった雌より寿命が長い．

Following successful eradication of the Screw-worm, *Callitroga hominivorax* from the island of Curacao, the value of utilizing induced sexual sterility for reducing insect population has been well established. LaBrecque (1961) tested three compounds, aphoxide, aphomide and apholate for their sterility effects on *Musca domestica domestica* and found them useful for the control of houseflies. Similar results were obtained by Gouck and his associates (1963) when apholate, tepa and metepa were applied to the pupae and adults of houseflies. Murvosh *et al.* (1964) conducted experiments to determine the effects of tepa, metepa and apholate on the longevity of flies and observed that metepa and apholate substantially shortened the life-span of the fly. Chang and Borkovec (1964) found tepa to be more effective than metepa and apholate in sterilizing male houseflies.

The investigations cited above relate to *M. d. domestica* and the authors are unaware of any studies concerning the effectiveness of chemosterilants against the predominant Indian house fly, *M. d. nebulo*. An attempt was, therefore, made to evaluate the efficiency of apholate as a chemosterilant for *M. d. nebulo* and to study its effects on the bionomics of this form of housefly.

Materials and Methods

Test insect and chemical

The flies used during the present studies were obtained from a normal strain of *M. d. nebulo* that is being maintained in the laboratory since 1961. They were kept at a temperature of 28° ±1°C and the larvae were reared on cotton pads soaked in diluted milk with sugar added.

The alkylating agent, apholate was obtained from Olin Mathieson Chemical Corporation, U. S. A. through the courtesy of Dr. Frank H. Dowell.

Experimental procedure

Individual adults were obtained by isolating pupae in vials over a plug of moist cotton wool. Single pair mating was then affected by placing the adults in small cloth-cages. Two groups of 15 pairs each were formed. One of these was fed on sugar treated with desired concentration of apholate, while the other was fed on untreated sugar. On the fourth day of emergence, petri-dishes containing milk soaked in cotton pads were introduced in the cages. These served as food and oviposition medium. Eggs obtained from each female were counted on a moist black cloth piece and percentage hatching of eggs was determined.

In another experiment 4 day old larvae of the same strain after being dipped in 1% apholate solution in alcohol for 60 seconds, were allowed to dry on a blotting paper and placed in glass jars containing the rearing medium. The pupae when 24-hour old were divided in two lots. One of which was dipped in 1% apholate solution in alcohol for 90 seconds while the other was left untreated. Thus two groups of adults,

namely those obtained from treated larvae and those from treated larvae and pupae were formed. Each of these group was further divided into two batches of 15 pairs each. One batch of each group was fed on apholate-treated sugar and the other on untreated sugar. They were provided with oviposition medium as described above.

In yet another experiment 24-hour old pupae were dipped in 1% apholate solution for 90 seconds and the adults obtained from them were kept in cloth cage for taking observations on the percentage hatching of the eggs.

Results

That apholate has a marked effect on the fertility and fecundity of houseflies is clear from table 1. Dipping of the larvae in 1% apholate solution for 60 seconds produced a net sterility of 58.9% as against 100.0% sterility obtained when the adults were fed on 0.025% apholate-treated sugar. This is in partial agreement to the earlier observations of Gouck *et al.* (1963) who obtained 100.0% sterility when adults of *M. d. domestica* were fed on 1% apholate-treated sugar but could not observe any significant reduction in the percent hatch of eggs when the larvae were dipped in 1% apholate solution for 30 seconds. Murvosh and his associates (1964) found the sterility to be 61.0% in the case of adults of *M. d. domestica* fed on 0.025% apholate treated sugar as against 100.0% sterility obtained during the present tests with *M. d. nebulo*. The percentage hatching of the eggs was greatly reduced when pupae of *M. d. nebulo* were dipped in apholate solution. As against 42.7% hatch obtained in the case of larval treatment, only 6.7% of the eggs hatched when pupae were treated. The degree of sterility was found to have greatly increased in experiments in which both the larvae and adults or larvae, pupae and adults were exposed to apholate formulations.

The above observations clearly prove that apholate is capable of inducing sterility in adults, no matter to which of the three stages, larvae, pupae or adults it is applied. Oral intake seems to be a more effective method for practical purposes where suitable baits can be found. LaBrecque *et al.* (1963) found metepa in baits to

Table 1. Effectiveness of apholate as a chemosterilant when applied to different stages of *M. d. nebulo*.

Stage treated	Concentration of apholate (%)			No. of eggs/fly		% Hatch	% Net sterility+
	L*	P*	A*	Oviposited	Hatched		
Larvae	1.0	—	—	182.8	76.2	42.7	58.9
Larvae and Pupae	1.0	1.0	—	74.6	4.1	5.4	98.8
Larvae and Adults	1.0	—	0.025	38.5	3.4	8.8	98.1
	1.0	—	0.05	27.2	0.2	0.7	99.8
	1.0	—	0.1	40.1	0.0	0.0	100.0
Larvae, Pupae	1.0	1.0	0.025	1.7	0.0	0.0	100.0
and Adults	1.0	1.0	0.1	0.0	0.0	0.0	100.0
	1.0	1.0	0.6	0.0	0.0	0.0	100.0
Pupae	—	1.0	—	—	—	6.7	—
Adults	—	—	0.025	20.3	0.0	0.0	100.0
	—	—	0.05	31.8	0.0	0.0	100.0
	—	—	0.1	36.2	0.0	0.0	100.0
	—	—	0.2	0.0	0.0	0.0	100.0
	—	—	0.6	0.0	0.0	0.0	100.0
Check (Untreated)	—	—	—	230.8	180.7	78.3	—

* L stands for larvae, P for pupae and A for adults.

\+ % net sterility calculated from formula suggested by Hair and Adkins (1964).

be effective against houseflies and a significant reduction in the viability of eggs was observed over a period of one month under field conditions. Treatment of more than one consecutive stages certainly enhances the sterility effects but the usefulness of such treatments can be realized only when the breeding sites of the insects are treated or sterilized insects are released. However, because of its toxicity it may not be desirable to apply apholate in the field indiscriminately.

The chemosterilant is more effective against *M. d. nebulo* than *M. d. domestica* and this may be due to specific differences between the two forms of flies.

Besides its sterilizing action apholate also affects oviposition and longevity of insects. Murvosh *et al.* (1964) observed that apholate substantially shortened the life-span of *M. d. domestica*. The longevity of *Popillia japonica* was also shortened when treated with this compound (Ladd, 1966). During the present studies the pre-oviposition, oviposition and post-oviposition periods of *M. d. nebulo* were found to be considerably affected when larvae or the adults were treated with apholate formulations (Table 2).

The pre-oviposition period was found to have considerably enhanced in the tests where the adults were fed on apholate. Treatment of larvae alone did not alter the pre-oviposition period much.

Apholate treatments also inhibited oviposition in flies, so much so that no eggs could be obtained in case of adults fed on 0.2% apholate-treated sugar. There was a lengthening of post-oviposition life in adult treatments. The longevity of both the males and the females was shortened and was found to be inversely proportional to the concentration tested. There was a marked difference in the longevity of females which oviposited and those which did not lay any eggs. In conformity with the findings of Lineva (1953) who observed a longer life-span in females of *M. d. domestica* which laid greater number of eggs, the longevity of female *M. d. nebulo* was longer in all cases where the females had oviposited.

The above observations clearly emphasize the need for detailed investigations on the effects of chemosterilants on the bionomics of economically important species of insects. The very fact that longevity is adversely affected by apholate treatments may prove to be a disadvantage in field operations where sterile males are released for reducing fly populations.

Summary

Efficiency of apholate as a chemosterilant and its effects on certain aspects of the bionomics of the common Indian housefly *Musca domestica*

Table 2. Effects of apholate on the oviposition and longevity of *M. d. nebulo*.

Stage treated	Concentration of apholate (%)		Individual Pairs		Duration in days			Longevity in days		
								Females		Males
	L*	A*	Observed	Oviposited	Pre-oviposition	Oviposition	Post oviposition	Oviposited	Not oviposited	
Larvae	1.0	—	15	14	4.1	9.4	5.3	18.9	21.0	17.2
Adults	—	0.025	10	3	7.3	1.0	9.0	17.3	20.1	17.3
	—	0.05	15	5	6.5	1.0	16.8	24.3	17.3	18.1
	—	0.1	10	6	8.1	1.0	15.3	24.4	17.5	18.9
	—	0.2	15	0	—	—	—	—	16.5	14.0
	—	0.6	15	0	—	—	—	—	13.4	8.0
Larvae and	1.0	0.025	10	4	8.5	5.5	12.5	26.7	16.0	22.7
Adults	1.0	0.1	15	7	7.3	1.0	19.2	27.5	18.0	20.6
	1.0	0.6	15	10	8.0	1.0	9.5	18.5	16.0	13.3
Check (Untreated)	—	—	10	10	5.0	12.9	7.5	25.4	—	25.1

* L stands for larvae and A for adults.

nebulo were investigated. The chemosterilant when applied to larvae, pupae or the adults significantly reduced the rate of oviposition and viability of eggs. It was most effective when adults were fed on sugar treated with it. Even the lowest used concentration of 0.025% apholate caused 100.0% sterility in the flies.

Treatments of adults alone or of the larvae and adults enhanced the pre-and post-oviposition periods but severely reduced the duration of oviposition in the flies. The longevity of both sexes was shortened when exposed to apholate formulations either in the larval stage or as adults. Females which oviposited lived longer than the ones which did not lay any eggs.

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References

Chang, S. C. and Borkŏvec, A. B.: *J. Econ. Entomol.* 57, 488～490 (1964).

Gouck, H. K.: *J. Econ. Entomol.* 57, 239～241 (1963).

Gouck, H. K., Crystal, M. M., Borkŏvec, A. B. and Meifert, D. W.: *J. Econ. Entomol.* 56, 506～509 (1963).

Hair, J. A. and Adkins, T. R.: *J. Econ. Entomol.* 57, 586～589 (1964).

LaBrecque, G. C.: *J. Econ. Entomol.* 54, 684～689 (1961).

LaBrecque, G. C., Meifert, D. W. and Fye, R. L.: *J. Econ. Entomol.* 56, 150～152 (1963).

Ladd, T. L.: *J. Econ. Entomol.* 59, 422～425 (1966).

Lineva, V. A.: *Obozr.*, 33, 161～173 (1953).

Murvosh, C. M., LaBrecque, G. C. and Smith, C. N.: *J. Econ. Entomol.* 57, 89～93 (1964).

Study on Attractant of the Rice Stem Borer, *Chilo suppressalis* Walker. Toshihiko KAWANO, Tetsuo SAITO (Laboratory of Applied Entomology and Nematology, Faculty of Agriculture, Nagoya University, Nagoya) and Katsura MUNAKATA (Laboratory of Pesticides Chemistry, Faculty of Agriculture, Nagoya University, Nagoya). Received July 23, 1968, *Botyu-Kagaku*, 33, 122, 1968. (with English Summary, 130).

16. ニカメイガの誘引物質について

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Oryzanone のニカメイガ *Chilo suppressalis* Walker 幼虫に対する誘引作用を再確認し，Oryzanone 関連化合物および芳香族の多数の化合物のうちから次の7化合物は同じように作用することがわかった．Acetoxyphenyl butanone, *n*-nonylaldehyde, β,γ-hexenol, methyleugenol, *sec*-butyl 6-methyl-3-cyclohexene-1-carboxylate, *p*-*n*-propoxybenzyl methyl ether, *p*-*n*-butoxybenzyl methyl ether. ニカメイガ幼虫の誘引作用に品種間差異があり，愛知旭，亀の尾は強く，黒大邱，千本旭，陸稲農林糯1号，農林8号は弱かった．処理間においては，多窒素区は普通区，珪酸区，2,4-D 処理区よりも誘引作用が強く，2,4-D 区は普通区よりも強かった．成虫の誘引作用は，亀の尾，黒大邱が強く，千本旭，陸稲農林糯1号は弱かった．窒素過多区と 2,4-D 区は普通区よりも誘引作用が強く，珪酸区は普通区よりも弱かった．

ニカメイガ *Chilo suppressalis* Walker 成虫に対する稲の誘引作用については古くから研究され，藍野[6]はニカメイガ成虫の水田への飛来に主要な役割を果すのは走化性であろうとし，和田[9]は第1世代幼虫による稲の被害の多少は，成虫の選択的産卵に支配されると報告している．多窒素栽培の稲には特に産卵数の多いことが瀬古[7]により観察された．笹本[8]は珪酸および窒素の単用と両者併用水稲をもちいて，ニカメイガ幼虫の加害に対する抵抗性について調べ，珪酸施用による被害の軽減，多窒素による被害の増加を認め，さらに珪酸あるいは窒素施用量を異にする稲に対する幼虫の選択的行動を観察し，稲に含まれているある種の化学成分に対して走化性を示すとのべている．Munakata *et al.*[4,5]は稲茎からニカメイガ幼虫の誘引物質を単離することに成功し，この誘引物質が稲に含まれるケトン物質の *p*-methylacetophenone であることから，Oryzanone と命名した．平野[1]は昆虫の寄主植物選好に関与する植物側の物質的要因として，

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