

INFLUENCE OF NINE SURFACTANTS ON THE ACTIVITY OF
OXYTETRACYCLINE HYDROCHLORIDE AGAINST
LIPAPHIS ERYSIMI KALT

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(Received for publication September 19, 1974)

The effect of nine surfactants on the activity of oxytetracycline hydrochloride (OTC) was investigated against *Lipaphis erysimi* KALT feeding on cabbage plants. All the surfactants, except Emulgator EL and Emulgator IP, at 0.1 % increased the efficacy of OTC at 0.25 % and a maximum reduction of 83.93 % in fertility was observed for the combination OTC+Arkopal N-110. The nymphal development was delayed by various treatments. The treated adults were lighter in weight and smaller in size as compared to the control insects. No phytotoxicity was observed in any case.

The chemical control of insect pests is increasingly difficult due to insect resistance to insecticides, toxicity hazards and deleterious effects on parasites and predators.^{1-3, 18-20} In the recent past there has been some work on the use of antibiotics to inhibit the reproductivity of different aphid species.^{4, 9-14, 16} LAL¹⁰ found oxytetracycline (Terramycin) to be very promising against *Aphis fabae* SCOP. The activity of oxytetracycline was increased to a great extent when combined with the synergist piperonyl butoxide or certain surfactants. Therefore, in the present studies nine surfactants were examined for their effects to improve the efficiency of oxytetracycline hydrochloride (OTC) against *Lipaphis erysimi* KALT.

Materials and Methods

A culture of apterous female aphids of *L. erysimi* KALT, breeding parthenogenetically, was maintained on cabbage plants. The seedlings of cabbage, *Brassica campestris* var. *capitata* (variety Pride of India), were obtained from the Vegetable Research Station, Kalianpur (Kanpur) and transplanted in small earthen pots filled with a mixture of soil, compost and sand. The adult apterous female aphids were released on each potted plant for 24 hours to deposit nymphs. The next day, the adults were removed and the newly born first-instar nymphs on the plants were sprayed with OTC in combination with different surfactants. The surfactants used in the experiment were obtained from Hoechst: Arkopal N-100, Arkopal N-110, Hostapan T, Leonil DB, Phenyl sulphonate CA, Phenyl sulphonate HSR, Emulgator IP, Emulgator EL and Emulgator A. Oxytetracycline hydrochloride at 0.25 % and each of the surfactants at 0.1 % concentration were used. The spraying was done with a hand atomizer and about 3 ml liquid were sufficient for complete coverage of a plant without any run off. Observations were taken for the development, weight, size and fertility rate of *L. erysimi*. The surfactants alone were also sprayed to see their own effects. The control plants received only water.

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Results

Nymphal Development

The period of nymphal development in the control was normally 6 days, except a few nymphs that required 7 days to become adults. But, after application of OTC, the period of development was delayed by 1 to 2 days or, in some cases, even more. The combination of some of the surfactants, namely, Arkopal N-100, Arkopal N-110, Phenyl sulphonate CA, and Phenyl sulphonate HSR increased the efficacy of OTC, and the development period was delayed by 2 to 4 days. Hostapan T, Leonil DB, Emulgator IP and Emulgator EL, however, did not increase the efficacy of OTC. None of the surfactants sprayed alone showed an effect on the development, and the treated insects developed normally as the control group.

Weight and Size

The weight and size of the insects were measured on the first day of their adult life. The average weight of control adults was 0.80 mg, whereas those treated with OTC weighed only 0.45 mg, a reduction of 43.75 %. The efficacy in reducing the weight of adults was increased when OTC was combined with the surfactants, Arkopal N-100, Arkopal N-110, Hostapan T, Leonil DB and Emulgator A. The other surfactants had no effect. The effect of surfactants alone was negligible, the weight of adults being reduced by only 1~4 % with some surfactants or increased by 1~6 % with others. A maximum reduction of 52.5 % in the weight of adults was achieved when the first-instar nymphs were treated with OTC in combination with Arkopal N-110.

The normal adults measured 2.13 mm in length and 1.09 mm in breadth. The application of OTC and its combinations with different surfactants reduced the size of developing adults to different degrees, as given in Table 1. The combination of OTC with Arkopal N-110 produced smallest adults which measured 1.26 mm long and 0.45 mm wide. Emulgator A and Leonil DB also increased the effects of OTC to some extent.

Reproductivity

The control adults produced, on an average, about 58 nymphs, while those treated with OTC could produce only about 12 nymphs in 12 days. The rate of reproductivity was thus reduced by 78.42 %. The effect of OTC was somewhat increased when OTC was combined with all the surfactants except Emulgator EL and Emulgator IP. A maximum reduction of 83.93 % in the reproductivity resulted for the combination OTC+Arkopal N-110, and of 82.58% for the combination OTC+Leonil DB. All the surfactants, except Leonil DB, when used alone, increased the rate of nymphal production by about 1~8 % over the control insects, the increase being significant only for Arkopal N-110, Hostapan T, Emulgator EL and Emulgator IP.

No phytotoxicity was observed in any case.

Discussion

HARRIES^{6,7)} and HARRIES and MATTSON⁸⁾ found that certain antibiotics caused larval mortality in three aphid species; no mortality was observed in the present studies. Our results are in accordance with the findings of EHRHARDT *et al.*⁵⁾, JAYARAJ *et al.*⁹⁾ and LAL.¹¹⁻¹³⁾ EHRHARDT and SCHMUTTERER⁴⁾ reported that the fertility rate of *Aphis fabae* SCOP. was reduced to a critical minimum or that even total sterility resulted when they introduced antibiotics in the artificial diet. In the present studies, when antibiotics were sprayed on plants bearing first-

Table 1. Effect of oxytetracycline hydrochloride (OTC) and its combinations with various surfactants on the weight, size and reproductivity of *Lipaphis erysimi* KALT

Treatment		Nymphs produced per adult	Reduction in nymphs produced	Average weight (mg)	Reduction in weight (%)	Average length (mm)	Average breadth (mm)
None		58.50	—	0.80	—	2.13	1.09
OTC		12.62	78.42	0.45	43.75	1.70	0.79
OTC +	Arkopal N-100	11.12	80.99	0.44	45.00	1.70	0.75
	Arkopal N-110	9.40	83.93	0.38	52.50	1.26	0.45
	Hostapan T	11.72	79.96	0.43	46.25	1.65	0.65
	Leonil DB	10.19	82.58	0.39	51.25	1.45	0.60
	Phenyl sulphonate HSR	12.22	79.11	0.45	43.75	1.71	0.72
	Phenyl sulphonate CA	11.81	79.81	0.45	43.75	1.68	0.75
	Emulgator EL	15.34	73.77	0.46	42.50	1.73	0.80
	Emulgator IP	14.11	75.88	0.45	43.75	1.69	0.73
	Emulgator A	11.78	79.86	0.40	50.00	1.40	0.62
Surfactants alone	Arkopal N-100	59.00	+ 0.85	0.78	2.50	1.98	1.00
	Arkopal N-110	62.12	+ 6.18	0.82	+ 2.50	2.10	1.09
	Hostapan T	61.72	+ 5.50	0.81	+ 1.25	2.21	0.97
	Leonil DB	57.75	1.28	0.77	3.75	2.00	0.87
	Phenyl sulphonate HSR	58.94	+ 0.76	0.85	+ 6.25	1.78	1.13
	Phenyl sulphonate CA	60.12	+ 2.76	0.82	+ 2.50	1.85	1.00
	Emulgator EL	63.00	+ 7.69	0.79	1.25	1.98	0.85
	Emulgator IP	60.92	+ 4.13	0.77	3.75	1.15	1.05
	Emulgator A	59.00	+ 0.85	0.83	+ 3.75	2.00	1.14
C. D. at 5 % level		2.31		0.03		0.12	0.22

instar nymphs, a maximum reduction of 83.93 % only resulted, which may indicate a lower uptake when antibiotics are sprayed on plants than when they are added to an artificial diet. JAYARAJ *et al.*⁹⁾ reported over 97 % reduction in the fertility of *A. fabae* treated with Terramycin at 0.2 % but LAL¹⁰⁾ found only 83.55 %, 90.66 % and 92.36 % reduction in the fertility of *A. fabae* treated with Terramycin at 0.2 %, 0.5 % and 0.7 % respectively. In the present experiment, OTC at 0.25 % reduced the fertility of *L. erysimi* by 78.42 %, and by 83.93 % when it was combined with Arkopal N-110. EHRHARDT and SCHMUTTERER⁴⁾ found that destruction of symbiotic microorganisms in the aphid mycetomes by various antibiotics was responsible for inhibition of reproductivity rates. A similar mechanism may also be involved in *L. erysimi*. Antibiotics have both contact and systemic actions against aphids¹⁰⁾ and may be used in combination with insecticides¹²⁾ or with other control methods in the field.¹⁷⁾ However, further investigations are required on the effect of various antibiotics against various insect species, both under laboratory and field conditions, before their practicability in plant protection can be assessed.

Acknowledgements

Thanks are due to the Council of Scientific and Industrial Research, New Delhi, for financial assistance to the senior author, and to M/S Hoechst Pharmaceutical Ltd., Frankfurt, W. Germany, for supplying the various surfactants.

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