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Toxicology

INFLUENCE OF WATER SALINITY ON TOXIC EFFECTS OF ENOLOFOS 50 AND OWADOFOS 50 ON RAINBOW TROUT AND TROUT SPERMATOZOA

WPŁYW ZASOLENIA WODY NA TOKSYCZNE ODDZIAŁYWANIE ENOLOFOSU 50 I OWADOFOSU 50 NA PLEMNIKI PSTRĄGA TĘCZOWEGO I TROCI

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Motility and viability of rainbow trout and trout spermatozoa exposed to insecticides ENOLOFOS 50 and liquid OWADOFOS 50 were studied. Constant contents of the toxicants were used in solutions of various salinity (from 0 to 18‰). The used concentrations of both insecticides, when applied in pure water "solution", caused no significant changes in motility of the spermatozoa. On the other hand, the insecticides applied at all the salinities used had toxic effects on the spermatozoa, the effects increasing visibly with salinity. The results obtained allow to conclude that the insecticides used may be more harmful in the sea than in fresh waters.

INTRODUCTION

Numerous authors have studied toxic effects of phosphoorganic insecticides on higher animals. However, with respect to fish the studies dealt usually with adult and juvenile forms, on a few occasions only the eggs and developing embryos being treated. To date, only one paper (Możdżer et al., 1984) dealt with toxic effects of insecticides on fish

spermatozoa. The ENOLOFOS 50 and liquid OWADOFOS 50 doses used in agriculture may prove toxic in waters inhabited by rainbow trout and trout, even after the waiting period. The present authors became interested in the problem of toxic effects of these insecticides on fish spermatozoa in the presence of NaCl (in estuaries or in the sea where insecticides are introduced with river runoff or via the atmosphere). Toxicity of pesticides to aquatic organisms (fish included) is known to depend, and markedly so, on physico-chemical properties of water, including salinity (Bauer, 1961). Although the above statement does not concern the salmonides reproducing in fresh waters, the studies presented are a sui generis model to conclude on effects of agricultural chemicals on other fish species reproducing in brackish waters; the fact that salmonid spermatozoa maintain their viability even in waters of a rather high salinity gives weight to the assumptions of the study.

MATERIALS AND METHODS

The tests were performed on spermatozoa of rainbow trout and trout. The best quality sperm (clean, uniform in texture, collected from fully mature males) was used in the assays. The sperm was collected at the capture sites (ponds, rivers) from 6 males of each species and brought to the laboratory in refrigerated thermos bottles within 5 hours from collection.

The spermatozoa were tested for:

a) their ability to become activated in the solutions used (a percentage of spermatozoa moving in the field of vision),
b) duration of movement.

The spermatozoa behaviour in toxicant-containing "solutions" was observed in:

a) various salt (NaCl) "solutions" of ENOLOFOS 50,
b) various salt (NaCl) "solutions" of liquid OWADOFOS 50,
c) controls in NaCl solutions of the following NaCl concentrations: 2; 4; 6; 8; 12; 14; 16; and 18 $^{0}/_{00}$.

The initial microscope magnification of 15x10 and the final one of 15x40 were used in observations. The spermatozoa motility was assessed by means of standard procedures (Tomasik, 1973). Each time the basic physico-chemical parameters of tap water (temperature and pH) that could possibly affect the spermatozoa were measured. The temperature of water and NaCl solutions used in tests was 12–15°C; pH ranged within 7.35–7.65. The spermatozoa viability and motility was tested at constant concentrations of insecticides in the "solutions", the concentrations being previously established experimentally at 0.01 ml/l and 0.03 ml/l for rainbow trout and trout, respectively (Możdżer et al., 1984).

The insecticides were used in NaCl solutions of various salinity (2; 4; 6; 8; 12; 14; 16; and 18$^{0}/_{00}$).

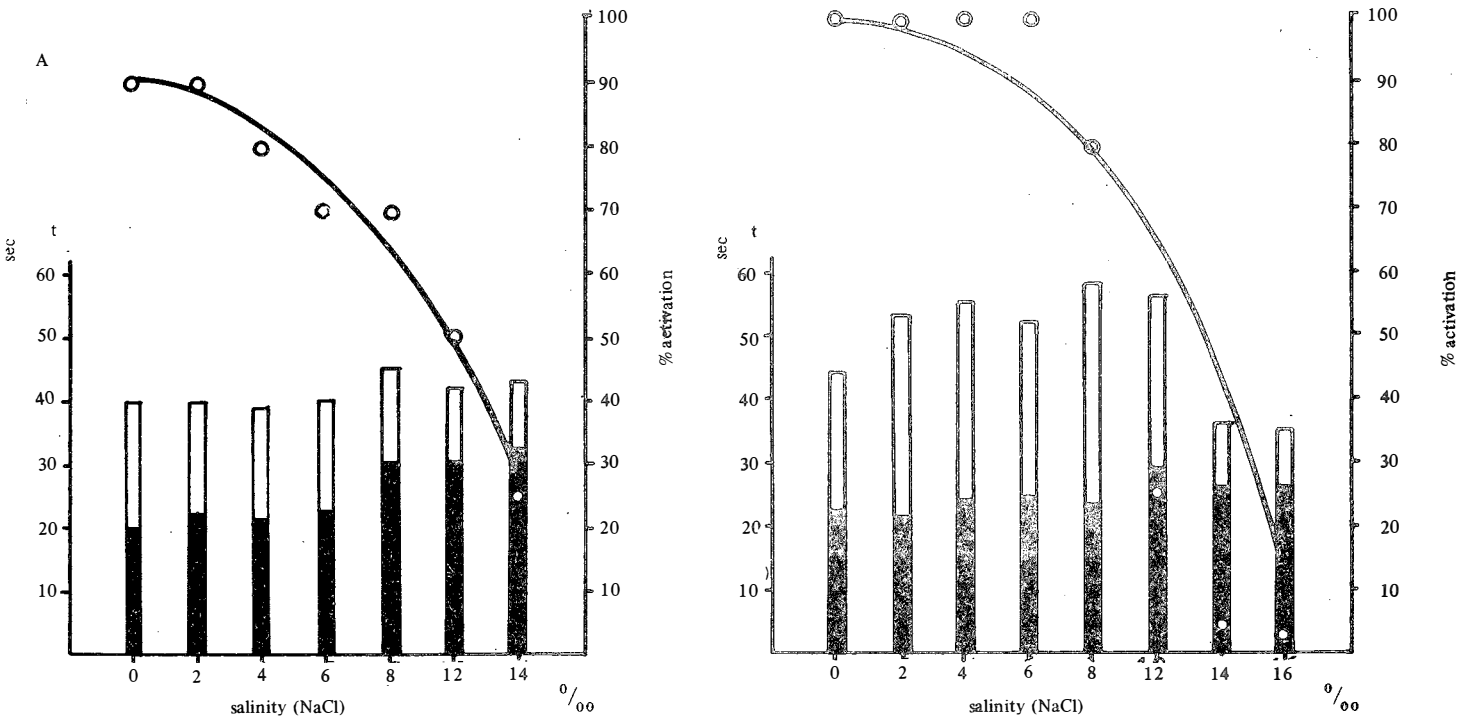

Fig. 1. Motility of *Salmo gairdneri* (A) and *S. trutta* (B) spermatozoa in relation to salinity
(▬ – progressive movement; ▭ – pendulum movement; ○○○ – % activation)

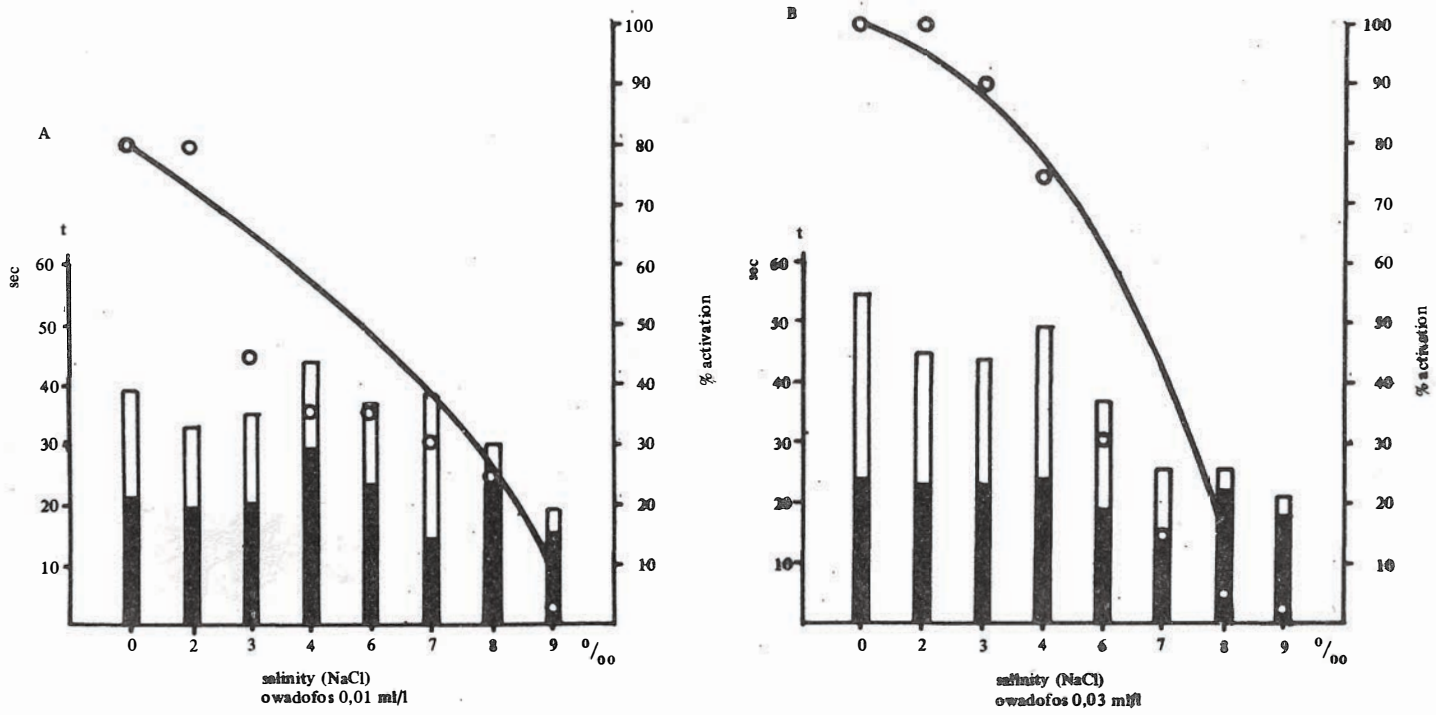

Fig. 2. Effects of constant concentrations of OWADOFOS 50 on motility of *S. gairdneri* (A) and *S. trutta* (B) spermatozoa in relation to salinity (▬ – progressive movement; ▭ – pendulum movement; ○○○ – % activation)

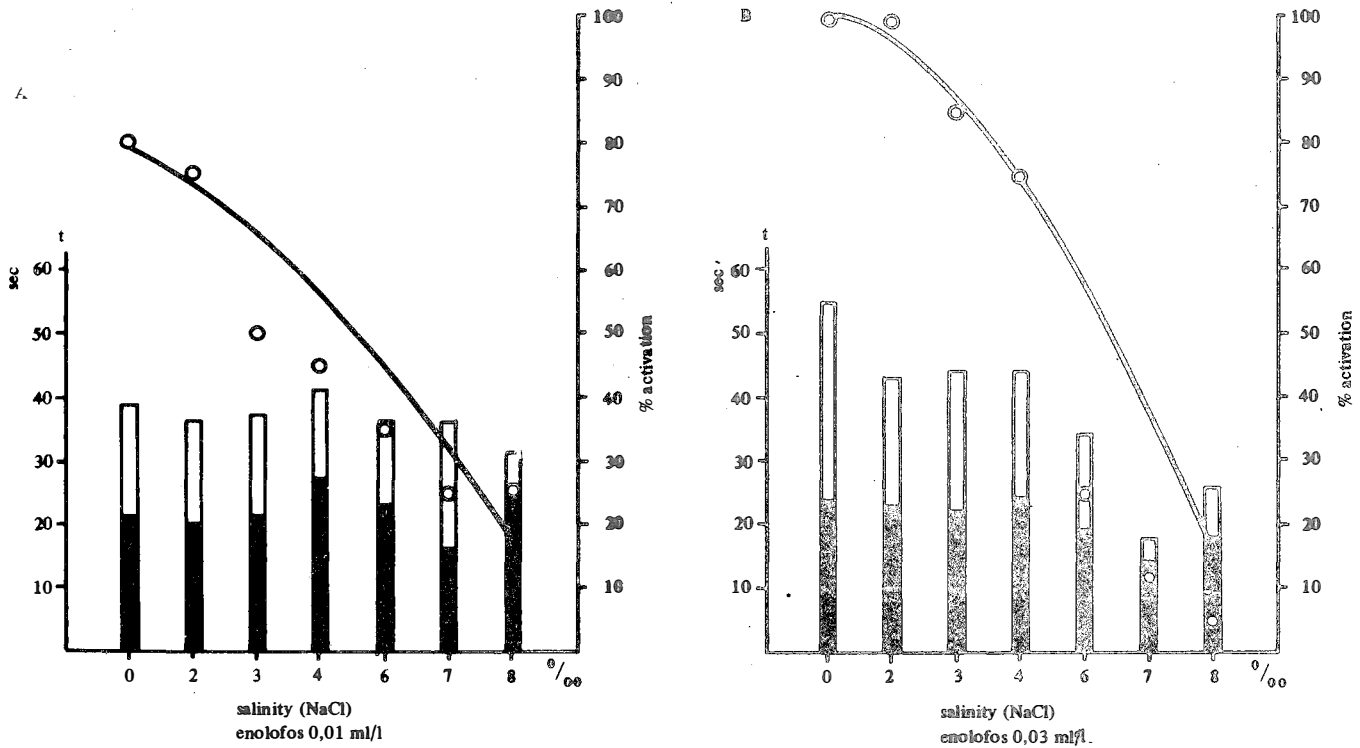

Fig. 3. Effects of constant concentrations of ENOLOFOS 50 on motility of *S. gairdneri* (A) and *S. trutta* (B) spermatozoa in relation to salinity
(■ – progressive movement; □ – pendulum movement; ○○○ – % activation)

RESULTS AND DISCUSSION

The results obtained are presented in Fig. 1-3. The experimental concentrations of ENOLOFOS SO and liquid OWADOFOS SO in pure water caused no significant change in the spermatozoa motility. On the other hand, the insecticides proved toxic in all NaCl solutions; for example, the cessation of movement was observed even at 9-10°/oo salinity, while the spermatozoa ceased to move at twice that NaCl concentration in pure solution of this salt.

The toxicity of ENOLOFOS 50 and liquid OWADOFOS SO to the rainbow trout and trout spermatozoa increases with increasing salinity. This is an accordance with findings of Bauer (1961) and Bock and Mann (1969) who observed a rapid increase in toxicity of pesticides (Bauer) and detergents (Bock and Mann) to crustaceans and fish, accompanying increasing salinity.

When viewed in the context of previous studies, the results obtained are interesting in that they show the presence in insecticide-contaminated water to increase the insecticides toxicity, while salt (in low concen{rations) in pure water is rather beneficial for the spermatozoa.

The results obtained allow to draw a general conclusion: plant protecting chemicals introduced - via river runoff or by the wind - to estuaries or directly to the sea may be more harmful there than in fresh waters.

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WPŁYW ZASOLENIA WODY NA TOKSYCZNE ODDZIAŁYWANIE ENOLOFOSU 50 I OWADOFOSU 50 NA PLEMNIKI PSTRĄGA TĘCZOWEGO I TROCI

STRESZCZENIE

Badano ruchliwość i żywotność plemników pstrąga tęczowego i troci poddanych działaniu insektycydów – Enolofosu 50 i Owadofosu płynnego 50 w roztworach o różnym stopniu zasolenia (od 0 do 18‰) przy stałych zawartościach toksykantów. Stwierdzono, że Enolofos 50 i Owadofos płynny 50, w zadanych stężeniach, nie powodujące w czystym „roztworze" wodnym istotnych zmian w ruchliwości i żywotności plemników, we wszystkich wariantach zasoleń oddziaływują na plemniki toksycznie z zauważalnym wzrostem toksycznego oddziaływania w miarę wzrostu zasolenia. Uzyskane wyniki pozwalają wnosić, że użyte środki ochrony roślin z chwilą dostania się do morza, gdzie zasolenia są większe, mogą wyrządzić większe szkody niż w wodach słodkich.

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ВЛИЯНИЕ СОЛЁНОСТИ ВОДЫ НА ТОКСИЧЕСКОЕ ВЛИЯНИЕ ЭНОЛОФОСА 50 И ОВАДОФОСА 50 НА СПЕРМАТОЗОИДЫ РАДУЖНОЙ ФОРЕЛИ И КУМЖИ

Р е з ю м е

Исследовали подвижность и живучесть сперматозоидов радужной форели и кумжи, подвергаемых действию инсектицидов – энолофоса 50 и Овадофоса жидкого 50 в растворах различной солёности (от 0 до 18‰) при постоянном содержании токсикантов. Определено, что Энолофос 50 и Овадофос Жидкий 50 в заданных концентрациях в чистом водном „растворе" не вызывают существенных изменений в подвижности и живучести сперматозоидов. Тогда как во всех вариантах солёности, токсически влияют на сперматозоиды, с заметным возрастанием токси-

ческого действия по мере роста солёности. Полученные результаты позволяют сделать вывод, что применяемые средства защиты растений, попадая в море, где солёность выше, могут вызывать больший вред, чем в пресноводных водоёмах.

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