OPTIMISATION OF SANITATION MEASURES IN AGRICULTURE WITH FOCUS ON DECREASE IN ENVIRONMENTAL POLLUTION AND HEALTH RISK

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Introduction

The objective of sanitation, which includes disinfection, insect control and rat control, is prevention of infection diseases or devitalisation of disease agents in the focus of disease. Besides good effectiveness of disinfectants, their risk to human and animal health and the environment should also be considered. Requirements on elimination of this risk induced research on effectiveness of disinfectants and particularly on danger associated with negative effects on the environment and animal health and on the so-called "selective toxicity" to target species.

Disinfection

The issues related to disinfection are as old as the medicine itself. The realistic approach to disinfection was put through by the end of 18th century. Pasteurs' theoretical basis of microbiology was introduced gradually into practice. The beginnings of the use of disinfectants date back to 1830 when Eberhard and Günter used chlorine lime to prevent postparturient complications in dairy cows.

Selective toxicity is defined as destroying of the target species without damage to other organisms. Selective effects aimed at devitalisation of micro-organisms with chemotherapeutics are based on differences between cellular physiology of parasites and natural mammal hosts (Albert, 1979). Such an action can be observed partially also with the disinfectants used. An example of selective action is differences in the effect of sodium hydroxide on vegetative micro-organisms, namely G^- and G^+. The mechanism of action of sodium hydroxide is based on hydrolysis of lipids and proteins and saponification of fatty acids. The cell wall of G^+ bacteria contains only small proportion of lipids which explains their increased resistance to the action of hydroxides (Ondrasovic et al., 2004). Opposite effect was recorded with the use of quaternary ammonium salts (Pokludová and Skaloud, 2002), as some G^- bacteria can survive their presence or even multiply in them.

Phenol belongs among the oldest disinfectants. In the past it was used as a substance against which other disinfectants were compared by means of the so-called "phenol coefficient". Its application is now limited or even banned because of its toxicity and its use as a test substance was also abandoned.

Chlorine preparations are extensively used at the present, practically in horizontal application. They are preferred due to their effectiveness against almost all groups of micro-organisms, reasonable price and relative harmlessness to the environment. Because of that they are also widely use for disinfection of drinking water. The present development in disinfectant preparations is oriented on combinations of various chemicals in order to decrease effectiveness through synergistic action. However, compared to conventional disinfectants, their prices are usually higher which reflects their limited use in horizontal disinfection. Biquanides, intended mostly for the use in food industry, were introduced to the market in the nineties of the past century and since then no novel disinfectant preparations have appeared (Melicharcíková, 2002).

Insect control

Systematic control of noxious insects was initiated only after introduction of chlorinated hydrocarbons to the practice. In 1948, Swiss scientist Paul Miller, the discoverer of DDT, was awarded Nobel price for his pioneer discovery. This substance marked a breakthrough in combating malaria and typhus.

DDT, the best of all chemicals in the time shortly after its discovery, showed how important it is to consider all the aspects of animal and human health and the environment in relation to disinfectants. This substance, originally considered as completely safe, is still detected in our environment, even in Polar Regions where it was never used but was transmitted there by air. Malaria is still endemic in Africa and according to Rettich (2002) 300 million of people suffer from this disease today and millions of them die. DDT, as the cheapest and very effective disinfectant, is still used in the countries of the third world and according to optimists it will be used at least till 2010.

The era of DDT was replaced by that of organophosphates and later by carbamates and synthetic pyrethroids. The development of insecticides is characteristic by that that considerable proportion of them was synthetised upon discovery of chemical composition of previously used natural insecticides. Synthetic insecticides exhibit better stability, lower toxicity and lower selection pressure on resistant individuals. We refer to the group of pyrethroids, derived from pyrethrum, neonicotin compounds and baits used particularly in the control of pharaoh ants, cockroaches and German cockroaches. An ecotoxicological

advantage of these baits is that they are not dispersed into the environment and can be easily removed. Moreover, we recognise also the so-called "domino effect" as cockroaches and German cockroaches eat the poisoned insects and die without coming into direct contact with the bait. Pharaoh ants transfer the bait into their nest and consume it there (Rupes and Ledvinka, 2002).

Chemical insecticides cause death of non-target aquatic and terrestrial, frequently very useful species, and in this way pose risk to respective biotopes. Industrial production of larvicidal preparation Bacillus thuringiensis israeliensis in Germany represents an important contribution to insect control. Since 1981, this preparation has been used almost exclusively to control mosquitoes in Germany and chemical disinfectants have been abandoned (Goldberg and Margalit, 1977).

Rat control

Application of principle of selective toxicity in the control of noxious rodents is more complex compared to disinfection and insect control and was not realised in practice. In this respect, "norbromid" was closest to this requirement and was tested on rats with regard to their effect on the vascular system. Very low doses of this compound induced death in rats and resulted in the use of norbromid in rat control (Steel et al., 2004).

The use in rat control of highly toxic substances popular in the past, such as strychnine and thallium sulphate, is banned. Of the acute rodenticides glycoside scillirozide (Verbiscar et al., 1986) and zinc phosphide are used. Zinc phosphide is an active ingredient in the preparation Stutox which is used mostly in the control of Microtus arvalis.

One serious disadvantage of acute rodenticides, besides toxicity to vertebrates and poultry, is the development of protective reflexes, risk of secondary poisoning and necessity of pre-baiting. Their use is indicated, for example, in serious epizootological situations.

Rat control is based mostly on anticoagulant rodenticides that are divided to three generations. The Ist generation preparations include those based on warfarin and the baits prepared from them contain 0.05 % of the active ingredient. Repeated consumption of baits is necessary. The IInd generation anticoagulants include for example brodifacoum and bromadiolon. Baits contain 0.005 % of the active ingredient. Brodifacoum is associated with the risk of secondary poisoning. The IIIrd generation anticoagulants include difethialon with baits containing only 0.0025 % of this substance which is a concentration below the physiological threshold of taste perception of rodents (Ondrasovic et al., 1996).

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