Studies about the effect of inert gases on the efficiency of phosphine to some stored product insects

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This work was carried out at the Institute ofstored products protection of the Federal BiologicalResearch Centre for Agri. and Pbrestry in BerlinDahlem (Fed. Rep. of l}ermany). The main objective- ofthese investieations was to study the effect of theinert gas carbon dioxide on the effecaoy of phosphineagainst some stored product insects. Larvae and pupaeof Sitotroga cerealella and adults of Sitophilus oryzaeand Tribolium castaneum were used in the Experiments.A recirculatory multi-flask apparatus was designedto prOVide a fumigation chamber for test insects. Phosphinewas generated from PHOSTIXI~-Pelletts.Biological studies were carried out to determinethe appearance times of larval and pupal stages ofSitotroga cerealella and adult emergence of Sitophilusoryzae and Tribolium .castaneum • It esults obtained wererecorded.Data achieved could be summarized under the followingtopioarI. Effect of phosphine on the tested insects:I.l. Larvae and pupae of Sitotroga cerealella:Probit analyses for toxicological data, obtainedto find the relative toxicity of phosphine to larvaland pupal stages of Sitotrolljacerealella exposed tovarying phosphine concentrations for 2, 4, 8, 24, 48and 72 hr. at 20°C and 28°C, showed that the LC50 ofphosphine decreased from average, 1609~g/L at 2 hr.to 4.59~g/L at 72 hr. for larvae at 200C and from1397 ~g/L to 4.36 ~5/Lat ~80C.In case of pupae the LC50 of phosphine declinedfrom 3056 ~g/L to 8.17 ~g/L at 20°C and from 2297 ~g/Lto 8.00 ~g/L at 280C.from these results we find that there was inver-sible relationship between the concentration and exposureperiod. Pupae of Sitotroga cerealella were moretolerant to phosphine than larvae. PHOSTOXI~ at 280Cwas more effective than at 200C.I.2. Adults of Tribolium castaneum and S1tophllus oryzae:The toxicological data obtained to find the relativetoxicity of phosphine to adults of Triboliumcastaneum ~nd Sitophilus oryzae exposed to differentconcentrattons and for 2, 4, 8, 24. 48 and 72 hr.exposure prriods at 28°C showed that the LC50 ofphosphine decr-eased from 70.4 /lg/L at 2 hr. to 2.)~/L at 72 hr. for Tribolium castaneum and from 128~/L at 2 hr. to 1.8/lg/L at 72 hr. for SitophiluSoryzae.There was also inversible relationship betweenthe concentration and the exposure period.II. Effect of carbon dioxide alone on the tested insects:The results indil~ated that carboh dioxide at shortexposure periods of 2, 4 and 6 hr. had a negligibleeffect on the mortality of larval and pupal stages of.§. cerealella.At longer exposure periods of 24. 48 and 72 hr.the effect of CO2 on the mortality of larvae and pupaeof .§. cerealella was noticeable. especially at 50 and78% concentrations.With respect to adults of Tribolium castaneum andSitophilus oryzae the effect of CO2 on the mortalitywas very low at 2. 4 and 8 hr. at all carbon dioxideconcentrations but was high at 24, 48 and 72 hr. at 50and 78% concentrations of CO2•III. Ettect of mixtures ot phosphine and CO2:Results obtained trom using mixtures ot LC50 ofphosphine and carbon dioxide concentrations showed highincrease in the mortalities ot larvae ot -S. cereal ellaat all exposure periods than of phosphine or carbondioxide alone.In case of pupae the resu.1ts revealed an increasein the mortalities at all exposure periods but thisincrease was lower than for larval stage. The morta1itiesat 28°C were higher than at 200C.Complete mortalities were recorded at all exposureperiods by using the mixtures ot carbon dioxide concentrationsand LC50 ot phosphine against adults ot T.castaneum and §. oryzae at 280C.Accordingly, lllixturesot vaI’3fingconcentrationsot CO2 + LC50 ot PHJ

induced higher insect-mortalities.Therefore we could re~l1ce the phosphine dose requieredin the tumigation , besides the potentiation ot theaction ot the gas.