

EFFECTS OF NONPESTICIDAL DUSTS AND MALATHION ON *TRIBOLIUM CONFUSUM* DU VAL.

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ABSTRACT

Numerous inspections of stored wheat have revealed intensified infestations of confused flower beetle *Tribolium confusum* lately. This was regarded as a consequence of less qualitative trashing and increase in percent of broken grain stored.

Diatomaceous earth (DE), Wessalone (WE) and product Insecto (IN) effects were compared to the insecticide Etiol Special (malathion) effect on confused flower beetle. The products DE and WE were applied at whole wheat grain in concentrations 0.35, 0.2, 0.1, 0.05, 0.01, 0.005 and 0.0025%. IN was applied at concentrations 0.7, 0.35, 0.2, 0.1, 0.05, 0.01 and 0.005 and malathion in concentrations 0.5, 0.25, 0.1, 0.05, 0.025, 0.01 and 0.005%.

The effects of inert dusts and malathion were determined upon daily counts of dead and paralysed larvae and adult insects (1-7th day and after 14th day of exposition). The mortalities were estimated and LC₅₀ (%) and LT₅₀ (h) determined.

Determined LD₅₀ of the products to adults were: DE 950-1580, IN 1170-1660, WE 440-870 and of malathion 520 - 813 g/t. To larvae LD₅₀ was found to be of IN 1700-2900, of WE 190, of malathion 280-660 g/t.

Dependent on concentration determined, LT₅₀ of adults were: DE 95-170, of IN 66-114, of WE 66, and of malathion 72 - 93. For larvae LT₅₀ were: IN 79-109, WE 105-155 and malathion 89 h.

IZVLEČEK

VPLIV NEPESTICIDNIH PRAŠIV IN MALATIONA NA MALEGA MOKARJA (*TRIBOLIUM CONFUSUM* DU VAL.)

Pri številnih pregledih vskladiščene pšenice so pozneje odkrili povečan napad malega mokaarja (*Tribolium confusum*). To so šteli kot posledico manj kakovostnega čiščenja in povečanega deleža zdrobljenega vskladiščene zrnja.

Učinek diatomejske zemlje (DE), Wessalona (WE) in pripravka Insecto (IN) so primerjali z insekticidom Etiol Special (malation) na malega mokaarja. Pripravka DE in WE so aplicirali na celo pšenično zrnje v koncentracijah 0,35, 0,2, 0,1, 0,05, 0,01, 0,005 in 0,0025%. IN so aplicirali s koncentracijami 0,7, 0,35, 0,2, 0,1, 0,05, 0,01 in 0,005%, malathion pa v koncentracijah 0,5, 0,25, 0,1, 0,05, 0,025, 0,01 in 0,005%.

Učinek inertnih prašiv in malationa so določili z dnevnim štetjem mrtvih in omrtvičenih ličink in odraslih hroščev (1.-7. dan in po 14. dnevu izpostavljenosti). Določili so smrtnost ter LC₅₀ (%) in LT₅₀ (h).

Vrednosti LD₅₀ pripravkov za odrasle hrošče so bile: DE 950-1580, IN 1170-1660, WE 440-870 in malationa 520 - 813 g/t. LD₅₀ za ličinke so bile: IN 1700-2900, WE 190 in malationa 280-660 g/t.

Odvisno od določene koncentracije so bile LT₅₀ odraslih hroščev: DE 95-170, IN 66-114, WE 66 in malationa 72 - 93, za ličinke pa: IN 79-109, WE 105-155 in za malation 89 h.

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1 INTRODUCTION

The species of genus *Tribolium* appear very often in fauna of beetles in storage houses and mills. Due to the great adaptability, species of this genus possess the character which makes it very dangerous pest in milling and processed cereal grain industry (Kosovac, 1968, Rončević, 1973, Banovački, 1995). Among the 33 described *Tribolium* species, nine were known by 1980 as serious or potential pests of stored products (Imura and Nakakite, 1984).

The past few years was observed that the efficiency of insecticide against confused flour beetle (*Tribolium confusum* Du Val.) was decreased. So it becomes the important pest of stored grain although this species mostly occur in mills. The new technologies in harvest, storage and grain manipulations, increase the number of broken kernel which resulted in the increase of grain damage.

Improving the new measures (storage pest control and reduce the application of pesticides) after 60 years, the inert dusts were introduced recently again. The aim of the investigation was the determination of dynamic and level of mortality of *Tribolium confusum* Du Val. larvae and imago, after treatment with diatomaceous earth, carrier Wessalon and the product Insecto.

2 MATERIAL AND METHODS

The experiments were done under laboratory conditions. The test insect was *Tribolium confusum* (confused flour beetle), both larvae and adults. The insects were reared in laboratory (at temperature $27 \pm 1^\circ\text{C}$, relative humidity 40-70% and no exposition with pesticides early). The experiments were conducted on wheat (with moisture 16%).

The method for pesticide dusts LC_{50} assessment (Šovljanski and Šmit, 1976) in four repetition with 20 adults and 10 larvae. The following dusts were used for grain treatment diatomaceous earth (DE) and Wessalon (WE) were applied at concentrations (w/w) 0,35, 0,2, 0,1, 0,05, 0,01, 0,005 and 0,0025%, or equal to dosages 3500, 2000, 1000, 500, 100, 50 and 25 g/t, Insecto (IN) at 0,7, 0,35, 0,2, 0,1, 0,05, 0,01 and 0,005% or dosages 7000, 3500, 2000, 1000, 500, 100 and 50 g/t) and Etiol specijal (1% malathion) at 0,5, 0,25, 0,1, 0,05, 0,025, 0,01 and 0,005%.

The mortality was estimated after 1, 2, 3, 4, 5, 6, 7 and 14 days upon the registered number of dead and paralysed individuals. The mortality was expressed in relative values.

LD_{50} and LT_{50} were calculated using probit analyses (Finney, 1971). 21 days after application, all the adults and larvae were removed, for assess the oviposition, insect development and appearance of the new generation in treated grain. In order to determine the newly emerged adults an inspecting of the experiment was done after 30 days.

The results are calculated in relative values and presented in tables and figures.

3 RESULTS

The results of non pesticide dusts action and malathion are presented as ld-p lines, lethal dosages (LD_{50}), lethal time (LT_{50}) and increase in mortality as response to product at three dosages: recommended, doubled and halved the recommended one.

The inert dust and malathion toxicity degree for *T. confusum* developmental stages is presented as ld-p lines in figures 1-4.

The ld-p lines of DE for confused flour beetle adults are presented in the Fig. 1. The obtained results show a different sensitivity heterogeneity adult population to DE. The range of dosages applied to adults was insufficiently broad for larvae testing (did not induce the measurable response to larvae), and the ld-p lines for larvae could not be constructed. These indicated the differences between larvae and adults sensitivity to DE. The larvae appeared less sensitive to DE than the adults.

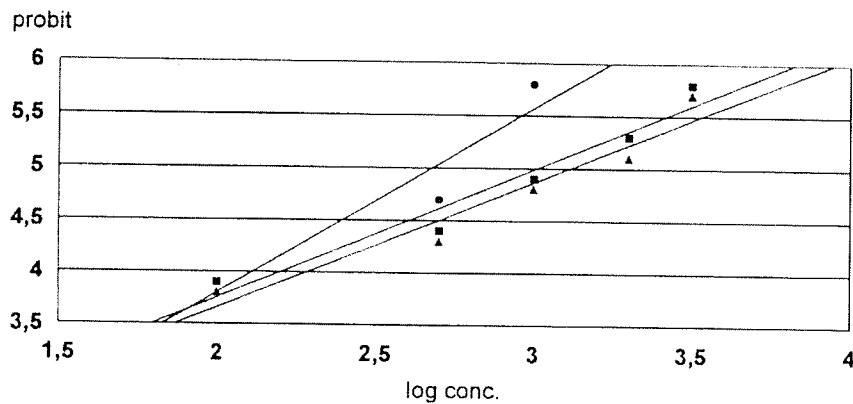


Figure 1: Ld-p lines of diatomaceous earth for adults of *Tribolium confusum* Du Val. (■ series 1 imago, ● series 2 imago, ▲ series 3 imago)

The ld-p lines of WE also indicated the heterogeneity in population of adults and larvae in response, although the larvae were more sensitive. The developmental stages differed in sensibility to WE and to DE (Fig. 2).

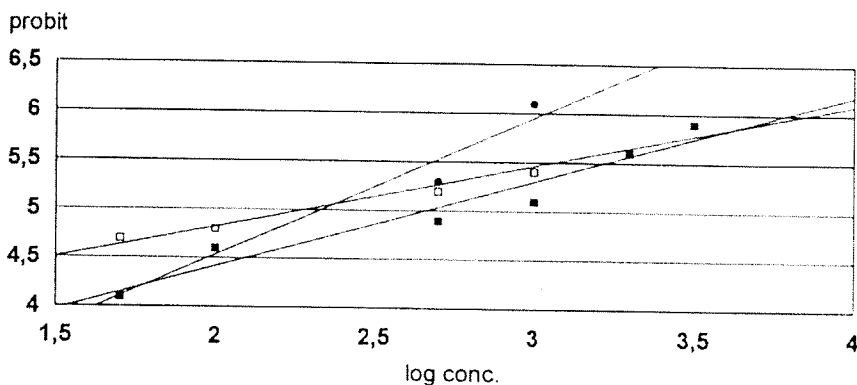


Figure 2: Ld-p lines of Wessalon for larvae and adults of *Tribolium confusum* Du Val. (■ series 1 imago, ● series 2 imago, □ series 4 larvae)

The slope of IN ld-p lines, indicated higher sensitivity of adults (compared with larvae) in spite of higher heterogeneity in reaction of adults than of larvae to this dust (Fig. 3).

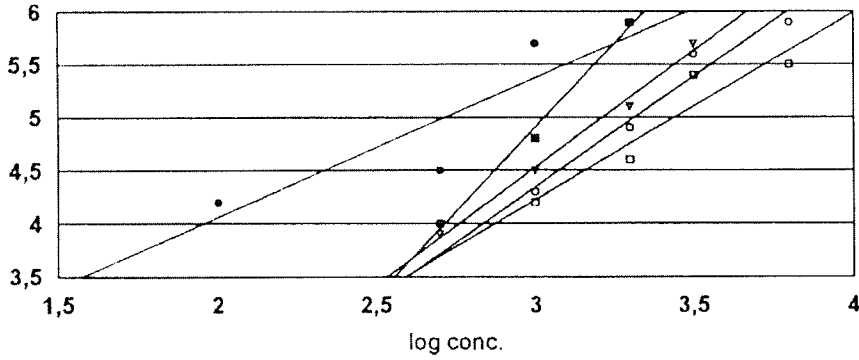


Figure 3: Ld-p lines of Insecto for larvae and adults of *Tribolium confusum* Du Val. (■ series 1 imago, ● series 2 imago, □ series 4 larvae, ○ series 5 larvae, ▼ series 6 larvae)

In figure 4 malathion ld-p lines are presented. The larvae appeared more sensitive than the adults. The heterogeneity in population sensitivity was also observed. Upon lc-p lines the medium lethal dosages (LD₅₀) as for products at recommended dose (g/t) were determined (LD₅₀) and presented. Also the medium lethal time (LT₅₀) is presented in tab. 1. in hours.

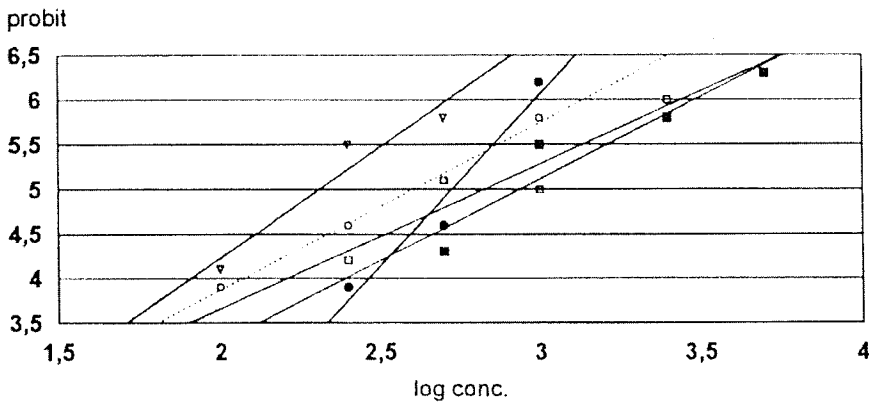


Figure 4: Ld-p lines of malathion for larvae and adults of *Tribolium confusum* Du Val. (■ series 1 imago, ● series 2 imago, □ series 4 larvae, ○ series 5 larvae, ▼ series 6 larvae)

In figure 5, LD₅₀ of DE approached or overcame the value of recommended dose. Only 50% mortality of confused flour beetle adults was achieved with recommended or slightly higher doses.

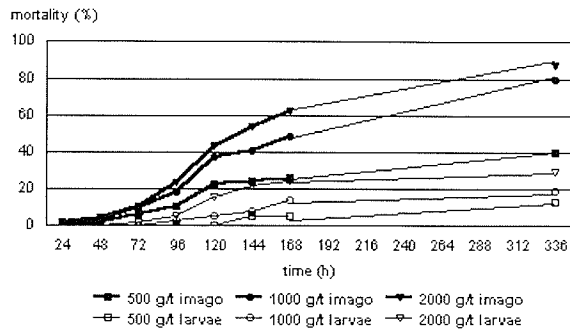


Figure 5: Daily increase in mortality of *Tribolium confusum* Du Val. induced by diatomaceous earth

The fig. 6. shows a difference between LD 50 of WE for adults and larvae. It was expected that 500 g/t will reduce exposed population at least 90-100%. Surprisingly the recommended dosage reduced the number of adult population only 50%. The larvae compared to adults revealed higher sensitivity, as the dose of 200 g/t resulted in 50% reduction. The recommended dose reduced successfully larvae but not adults.

The effect of IN on adults is similar to the effect of DE. The adults revealed decreased sensitivity, as the dose higher than recommended decreased. The larvae were less sensitive than adults, e.g. the dose of 2000 g/t reduced the larvae population only 50%.

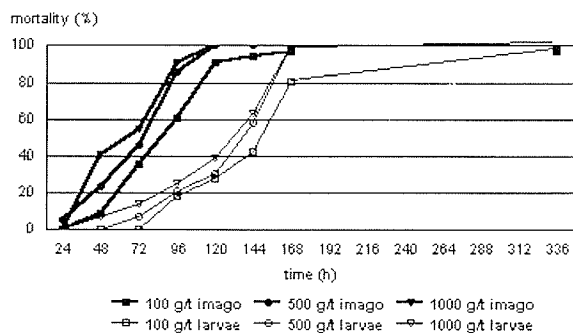


Figure 6: Daily increase in mortality of *Tribolium confusum* Du Val. induced by Wessalon

The toxicity of malathion to larvae and adults, determined upon LD50, indicated approximately the same sensitivity. LD50 for larvae and adults are estimated to be lower than recommended doses. The reason is still good sensitivity to this insecticide in spite of long use in storage. Therefore the use of malathion is still justified in confused flour beetle control.

Table 1: Toxicity (LD₅₀) and velocity action (LT₅₀) of non pesticidal materials and malathion to larvae and adults of *T. confusum* on wheat

LD ₅₀ (g/t)	b	LT ₅₀ (h)	days	dose (g/t)
Diatomaceous earth				
adults				
950	1,30	169,8	7	1000
1200	1,31	144,5	6	2000
1580	1,22	95,5	4	3500
1000 g/t*				
Wessalon				
adults				
440	1,63	66,83	>2	500
870	0,34	-	-	-
larvae				
190	0,55	155,33	>6	1000
-	-	125,9	>5	2000
-	-	105,76	>4	3500
500 g/t*				
Insecto				
adults				
1170	2,38	104,7	>4	1000
1660	1,88	66,07	>2	2000
larvae				
1700	2,22	109,6	>4	3500
2180	2,13	79,43	>3	7000
2900	1,65	-	-	-
500-1000 g/t*				
Ethiol special (1% malathion)				
adults				
520	3,7	93,32	>3	250
813	1,73	72,44	3	500
larvae				
280	2,11	89,12	>3	250
450	1,88	-	-	-
660	1,67	-	-	-
1000 g/t*				

* Recommended dose

According to data in tab. 1. velocity of action (presented as LT₅₀) differs depending on inert dust or insecticide, but in all cases is in according recommended dose.

In fig. 5-8, the daily increase in mortality of adults and larvae during 14 days exposition to the doses doubled, halved of- and recommended dose.

In fig 5. the higher mortality of adults and larvae is registered for higher doses of DE. The distinct increase in mortality is observed only after 72 h.

The effect of WE (fig.6) correlated to the doses applied, although two times higher and 5 times smaller dose of recommended one, induced mortality response in narrow range. Faster action on adults in comparison to larvae is clearly seen. The increase in mortality of adults occurred after 24 h, and of larvae after 48 h.

The mortality increase induced by IN is presented in fig. 7. Higher mortality of adults was noticed after 48 h, and of larvae after 72 h of exposition. The recommended dose effect was higher on adults than on larvae.

The mortality increase of adults and larvae after exposition to malathion are presented in fig. 8. Already after 24 h it was observed high initial mortality. The dose of 1000 g/t was highly effective, nearly the same as of 2000 g/t. The reduction of dose, to half of recommended one, slowed down the effect. The similar effects were registered of 1000 g/t on adults and 2000 g/t on larvae.

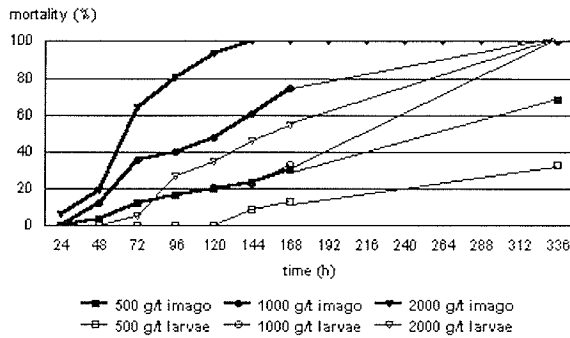


Figure 7: Daily increase in mortality of *Tribolium confusum* Du Val. induced by Insecto

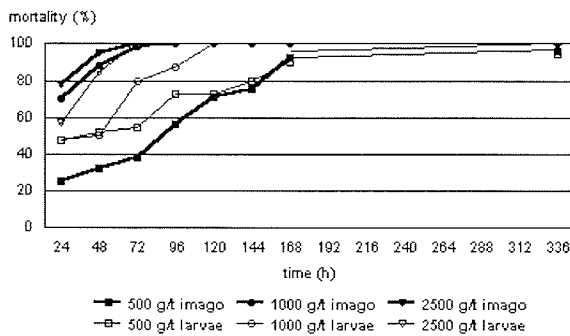


Figure 8: Daily increase in mortality of *Tribolium confusum* Du Val. induced by malathion

Population recovery of confused flower beetle after used of non pesticide dusts are presented in tab. 2.

Table 2: Number of newly emerged adults of *T. confusum* in treated wheat compared with control

diatomaceous earth		Wessalon		Insecto		Malathion	
g/t*	(%)	g/t*	(%)	g/t*	(%)	g/t*	(%)
3.500	0	3.500	0	3.500	0	5.000	0
2.000	0	2.000	0	2.000	38,1	2.500	0
1.000	38,1	1.000	0	1.000	104,8	1.000	0
500	66,6	500	0	500	85,71	500	57,1

g/t* - dose applied

(%) – the number of new adults (adults in control = 100%)

New generation of this beetles appear on treated wheat with DE in lower concentration of 0,1 %, but on same products new generation of *Sitophilus granarius* appears at much higher dose rate (Indjić *et al.*, 1998). The population of confused flour beetle is not recovered of any dose rate of WE. New generation appear only at lower dose rate than 3500 g/t wheat treated with IN. New generation on wheat treated with malathion appear only at lower dose than recommended.

4 CONCLUSIONS

According to the trial results we can conclude the followings:

Growing stage of larvae and adults shows different susceptibility to non pesticide dusts and malathion.

The LD₅₀ lines of all inert dusts and malathion indicated the heterogeneity of adults and larvae, but higher heterogeneity in reaction of adults of IN and DE. The larvae appeared more sensitive than the adults of WE and M.

LD 50 of DE and IN in recommended dose are not enough to reduce successfully larvae and adults, but WE and M can be used in recommended dose.

The daily increase in mortality shows that all dusts action was faster on adults in comparison to larvae.

Generation was not renewed on WE, but on DE, IN and M adults emerged in treated wheat on lower concentration of 0,1 % (DE), 0,2 % (IN) and 0,05 % (M).

5 LITERATURE

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