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# FORMULATION AS A FACTOR AFFECTING THE CHEMICAL ACTIVITY OF INSECTICIDES AGAINST SITOPHILUS ORYZAE (L.)(COLEOPTERA: CURCULIONIDAE)

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## ABSTRACT

Tests were made to determine the toxicity of four inert dusts (talc, kaolin, silica gel and ash) and three selected pesticides (malathion, pirimiphos - methyl and cypermethrin) formulated as 0.1% dust formulation, based on the different inert dusts and applied to wheat grain (14.4% moisture content ) against the rice weevil , Sitophilus oryzae (L.).

The inert dusts were tested in different weights ranging bettwen 0.10 and 4.00 mg\ 50 gm wheat to determine their insecticidal efficacy and their effect on the mean number of emerged progeny. In addition the $LC_{50}$ values were calculated for each used pesticide based on different used inert dusts after 7days of bioassay .

The results, show that silica gel and ash as proved to be active against S.oryzae and their progeny .

Moreover, the combination of ash\malathion, kaolin\ pirimiphos - methyl and silica gel\ cypermethrin showed sort of potentiation against S.oryzae and this finding could be attributed to less hazard to environment based on less amount of chemicals used in the control .

## INTRODUCTION

Extraneous materials such as lime, wood ashes, sulfur, silica gel, diatomaceous earth and salt have been used with the intention of preventing insect infestation in stored graim (La Hue, 1970 and Varma and siddiqui, 1977). Also attapulgite dust was used by Pandey and Varma (1977) against the pulse beetle.

Protective dusts and sprays have been used that incorporate small amounts of insecticide which kills insects but is relatively harmless to man and domestic vertebrates in the quantities applied. Meanwhile, to use minimum effective deposits of an insecticide in a formulation that will be removed to the greatest degree by milling process. So, the tested compound could be effective on a specific carrier more than it is on another and could be used in small amounts to achieve that aim and less costs will be needed .

Sevreral studies on the use of malathion as grain protectant include those of Lemon (1967) and EL-Rafie et - al. (1975). Meanwhile the widespread resistance of stored product insects to malathiion (Zettler, 1974 and Champ and Dyte , 1976) has necessitated the evaluation of alternated grain protectants. Pirimiphos-methyl was succefully used against resistant strains of stored product insects (Wildey, 1977; Bansode et al. 1981 ; Patrick and wilson, 1987 and Tayeb ,1988). Also synthetic pyrethroids has been evaluated on grain against stored product insects in Australia ( Bengston et al. 1983 and Noble and Hamilton, 1985). Permethrin dilute dust was succefully used for control stored product insects (Taylor and Evans, 1980 ; Adesuyi, 1982 ; and Hodges and Miek, 1986).

The cheapest and most effective method to protect the grain against insect attack is to use residual synthetic insecticide admixed with the grain prior to deposition in the storage bin or silo. There is some evidence from early work on pyrethrum that the insecticidal action of dust formulation lasts longer than that of emulsions (Lindgren et al. 1954 and Mammen and Nair, 1968). Rowland (1967) quoted unpublished results showing considerably greater persistonce of malathion dust formulations than water-based emulsion on wheat.

Silica-based dust for the control of insects infesting dried sea fish have been used by Kane (1967), and Hose (1984) against S.granarius and talc-based dusts of malathion and deltamethrin have also been reported by Tayeb (1988).

The aim of this study is directed to evaluate talc,ash,Kaolin and silica gel as based dust formulations for malathion, pirimiphos-methyl and cypermethrin against the rice weevil Sitophilus oryzae (L.).Moreover,to find out which carrier will be enhanced the pesticide toxicity based on toxicity index as $LC_{50}$ value.

## MATERIALS AND METHODS

### Insecticides :-

-Cypermethrin : (RS)-α-cyano -3-phenoxybenzyl (IRS)-cis, trans - 3 (2,2-dicblorovinyl)- 2,2 - dimethyl cyclopropanecarboxylate.It was supplied by Cib Geigy co.,Switzerland as 90% technical material.

- Pirimiphos-methyl : 0-2- diethyl amino-6-methyl primidin-4-yl 0,0-dimethyl phosphorothioate.It was supplied by ici co., U.K as 97 %. technical material.

**- Malathion: S-1,2-bic (ethoxycarbonyl)ethyl 0,0-dimethyl phosphorodithioate. It was supplied by American cyanamide co., U.I.A. as 98.4 %, technical material.**

<u>Insect</u> :-

Susceptible strain of <u>S</u>.<u>oryzae</u> were obtained from Sil-wood Berk., Insectory, Imperial College, U.K. whole wheat was used as the culture medium for rearing the insect in glass jars (2 L.) covered with muslin. After two weeks of adding 200-400 adult weevils from a previous culture in each jar, the insects were sieved out of medium and the wheat grain of 10 jars was transefered to a plastic bucket, its top painted with Fluon to prevent insect escaping. The insect was reared at 25 ± 2 C and 70 ± 5% R.H. Adults 2-3 weeks after emergence were used for the experimental work.

<u>Insecticidal efficacy of inert dusts</u> :-

Four inorganic dusts namely; talc, ash, silica gel and kaolin were tested against <u>S</u>.<u>oryzae</u> to determine their insecticidal efficacy. whole wheat (Sakha 8 variety) having a moisture content of 14.4% was admixed with the dusts at a range of concentrations of 10-4000 mg/50gm wheat. The moisture content (m.c.) was determined by the A.O.A.C. oven method (Horwitz, 1970). <u>S</u>.<u>oryzae</u> (50 unsexed adult, 2-3 weeks old) were introduced and the mortality percentages were recorded after 7 days. The adults were sieved from the wheat and the wheat samples incubated at 25 ± 20 C in sealed jars (1 b.) for a further 9 weeks. Newly emerged adults (alive and dead) were separated from wheat grain and counted.

The preparation of 0.1% pesticide dust formulations using technical pesticides based on different used carriers was carried out by the method described by Tayeb (1988).

Bioassay of S.oryzae on wheat treated with pesticide formulation :-

50 gm wheat samples having a moisture content of 14.4% were weighed into 1 lb. jam jars. Samples of each pesticide dust formulations were weighed onto aluminium foil. The dust formulations were added to the wheat and the jars covered with a piece of cling film and a lid.The method for mixing pesticide dust formulations with whole wheat was as the same as that described by Singh (1981).Then the jars were pointed with Fluon to prevent insect escaping and to allow insects to be contacted with the treated wheat.(50)Adult insects 2-3 weeks from emergence were used for all bioassys and incubated at 25 ± 2 $^{\circ}$C for 7days. The wheat was then tipped onto a tray with Fluon-coated sides and the insects were separated. They were categorized as alive or dead (brittle and showing no movement over a 5 min.observation period ).

Probit (mortality)\log (does) regression equation and lines for the dust formulations were calculated and plotted using the maximum likelihood algorithm(1952)adopted as a BASIC computer program.At least 5 doses of each insecticide formulations were used to obtain each regression line. $LC_{50}$ vallues and associated fiducial limits were calculated by the method described by Finney (1952) and goodness of fit of the experimental data to the regression equation was estimated by Pearso's Chi squared.

## RESULTS AND DISCUSSION

Toxicity of four inorganic carriers admixed with wheat grains are demonstrated in Table 1. The results show that the percent mortality of Sitophilus oryzae increase parallel to an increase in the concentration of the carrier . The treatment with ash and silica get at the higher concentration than 200 mg\50 gm showed remarkable effect.on Sitophilus adults.On the other hand talc and kaolin showed less activity than ash and silica gel.The treatment with 4000 mg\50 gm caused 81% and 55% mortality, respectively .

With respect to the effect of treatment with different inert dusts on the resulted progenies,it was obvious and remarkable reduction at different rates in the size of the offspring population (Table 1 & Fig. 1). In addition the inert dust showed varied effect on the total progeny resulted when a completly inhibition of S. oryzae was observed after treatment with 200 mg\50 mg of silica get. Regarding the treatments with talc and kaolin , the results declared a less effect on S.oryzae as effect than compared by silica gel and ash. However,a relatively dose dependent effect of the later inert dusts was observed.Where on which the increase of the used concentration achieved remarkable reduction rate in the number of the resulted offsprings.The mortality percent in the progeny was increased with the increase of the concentration and the type of the inert dust.

From the aforementioned results,it could be concluded that silica gel and ash posses a comperhenisive activity against _S. oryzae_ and could be recommend to be good tool for controlling such insect .

These results are in agreement with those reported by La Hue (1970) that silica aerogel at 60 pounds per 1.000 bushels of wheat afforded nearly complete protection from insect damage for 12 months. Moreover, the result obtained by Khare and Agrawal (1972) showed that 1.5% cow dung ash mixed with wheat gave 80%mortality after 3 weeks storage.

Estimated values for the parameters of the Normal Equiralent Deviate (N.E.D.)of(response)\ long (dose)regressions for silica get, talc,ash and kaolin-based dust formulations of malathion, pirimiphos-methyl and cypermethrin applied individually to wheat and tested against the susceptible strain of _S. oryzae_ at 7days,bioassay are shown in Table 2 days,together with probabilty corresponding to Chi-square values for fit of the data to the regression lines.Also,Fig. 2(a,b c)illustrated the probit (response)/log (dose) regression lines for each pesticide based on the different used carriers. Differences between formulations in the effectiveness of insecticides applied in dusts against _S. oryzae_ were clearly defined. In general, cypermetrin dust formulations 0.1% w/w based on the different used carriers (except ash) were the most efficient insecticide formulations against _S. oryzae_ at the $LC_{50}$ level and the most efficient formulation was cypermcthrim/silica gal. The 7 days $LC_{50}$ OF The silica gel/cypermethrin formulation at 0.1% w/w is about four times lower than those of talc/malathion or ash/ pirimiphos-methyl ,respectively. Meanwhile,the 7 days $LC_{50}$ of the ash/cypermethrin formulation was about equal with that of the silica gel/malathion formulation. Ash-based dust formulation of malathion (ash/malathion) was the

Table 1 . Influence of different carriers added to wheat grain on mortality percent and total number of emerged S. orayzae.

| Material / Conc. mg/50gm wheat | Mortality % | | | | Total number of emerged | | | |
|---|---|---|---|---|---|---|---|---|
| | Talc | Ash | Silica | Kaolin | Talc | Ash | Silica | Kaolin |
| 0 | 2 | 2 | 2 | 2 | 194 | 194 | 194 | 194 |
| 10 | 7 | 14 | 12 | 15 | 169 | 160 | 129 | 179 |
| 50 | 20 | 18 | 32 | 19 | 148 | 81 | 49 | 162 |
| 100 | 29 | 33 | 39 | 26 | 132 | 75 | 44 | 151 |
| 200 | 47 | 98 | 99 | 43 | 120 | 19 | 0.0 | 148 |
| 400 | 64 | 99 | 100 | 53 | 103 | 18 | 0.0 | 145 |
| 600 | 75 | 100 | 100 | 53 | 83 | 16 | 0.0 | 134 |
| 800 | 76 | 100 | 100 | 55 | 85 | 16 | 0.0 | 113 |
| 1500 | 75 | 100 | 100 | 60 | 73 | 15 | 0.0 | 106 |
| 2000 | 73 | 100 | 100 | 62 | 37 | 13 | 0.0 | 93 |
| 2500 | 75 | 100 | 100 | 64 | 37 | 10 | 0.0 | 67 |
| 3000 | 79 | 100 | 100 | 56 | 31 | 8 | 0.0 | 63 |
| 3500 | 79 | 100 | 100 | 57 | 20 | 7 | 0.0 | 45 |
| 4000 | 81 | 100 | 100 | 55 | 15 | 0.0 | 0.0 | 40 |

**Fig.1. Influence of different treatment on the total number of emerged S.oryzae in relation to their latent effect.**

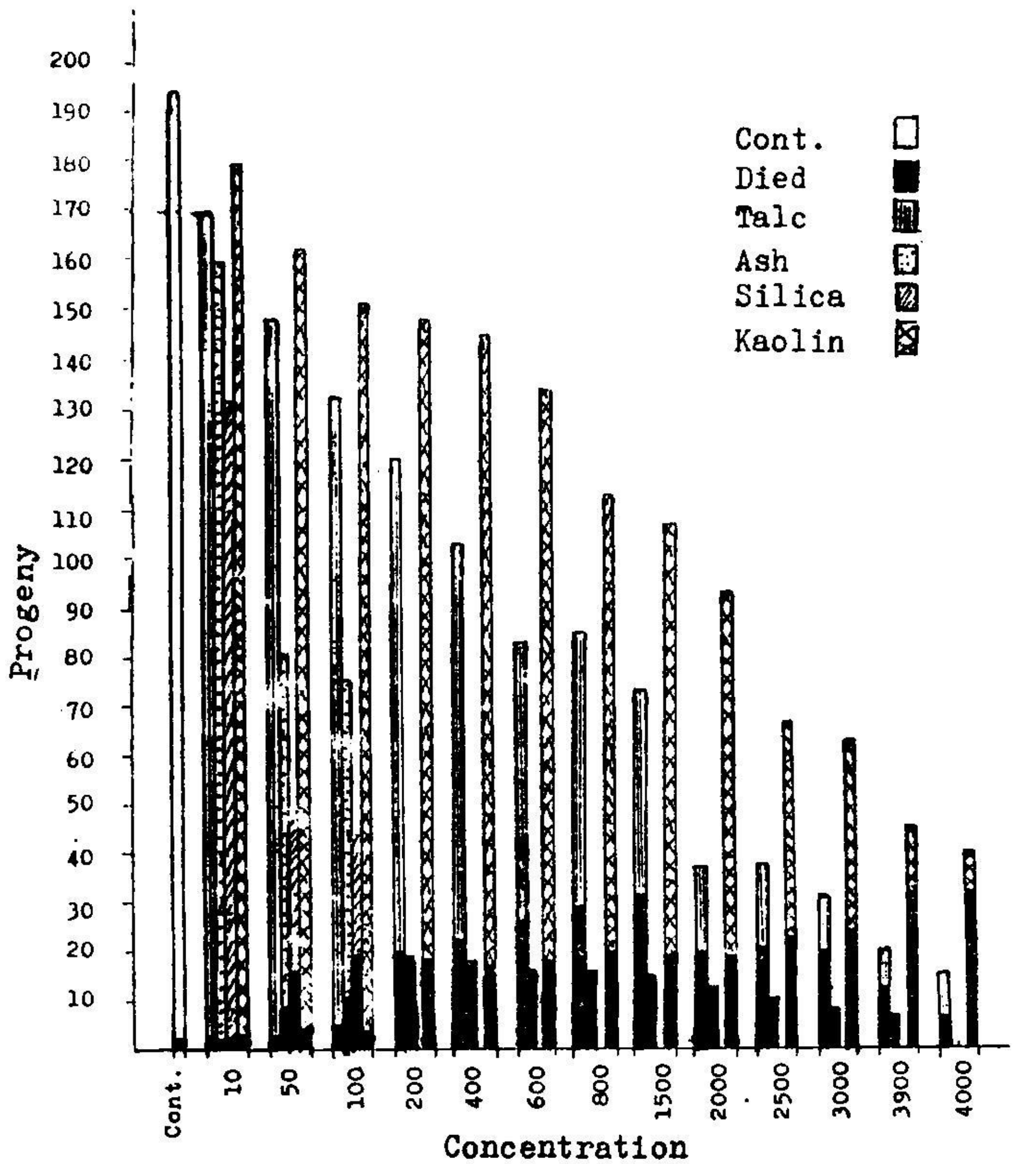


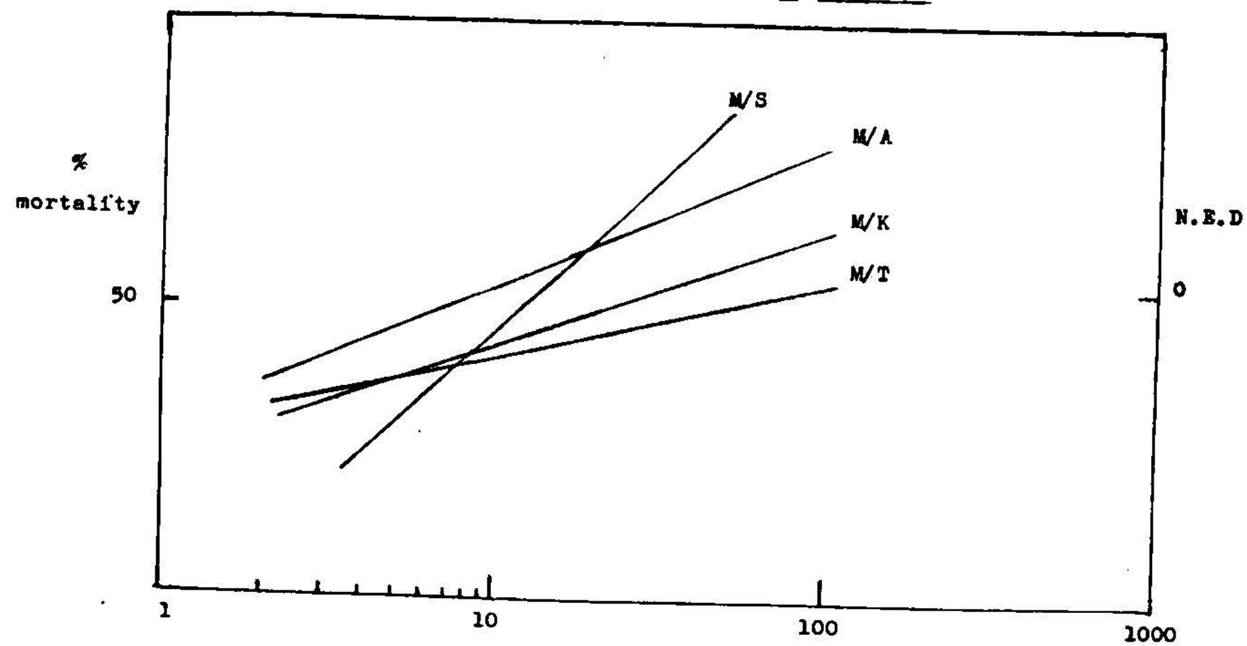
Table 2. Response of S. Oryzae to 0.1% of different insecticides dust formulations after 7days of treatment.

| Pesticides | Carrier | Regression of N.E.D. response (y) on log dose (x)* (Maximum likelihood estimate) | $LC_{50}$ mg/50 gm wheat | 95% fiducial limits (lower - upper) | Goodness of fit P** |
|---|---|---|---|---|---|
| Control | | 1.38 + 0.81 | 50.064 | 32.603-78.444 | |
| Malathion | Talc | y= -1.40 + 0.82 x | 51.250 | (33.310-80.457) | 0.966 |
| | Ash | y= -1.35 + 1.53 x | 7.570 | ( 6.044- 9.430) | 0.441 |
| | Silica gel | y= -3.70 + 3.44 x | 11.896 | (10.476-13.507) | 0.781 |
| | Kaolin | y= -1.63 + 1.20 x | 22.458 | (17.655-28.593) | 0.894 |
| Pirimiphos methyl | Talc | y= -3.39 + 2.79 x | 16.311 | (13.983-19.037) | 0.710 |
| | Ash | y= -2.63 + 1.74 x | 32.203 | (25.366-40.996) | 0.984 |
| | Silica gel | y= -2.21 + 1.97 x | 13.314 | (11.006-16.156) | 0.881 |
| | Kaolin | y= -1.80 + 1.88 x | 9.123 | ( 7.598-10.950) | 0.847 |
| Cypermethrin | Talc | y= -1.83 + 2.08 x | 7.558 | ( 6.330- 9.007) | 0.131 |
| | Ash | y= -2.21 + 2.10 x | 11.267 | ( 9.511-13.346) | 0.506 |
| | Silica gel | y= -1.74 + 3.69 x | 2.969 | ( 2.524- 3.474) | 0.248 |
| | Kaolin | y= -2.03 + 2.54 x | 6.274 | ( 5.375- 7.317) | 0.781 |

* Data based on concetration units of mg 0.1% formulation/50 gm wheat.

** P = probability correspondingto Chi-square.

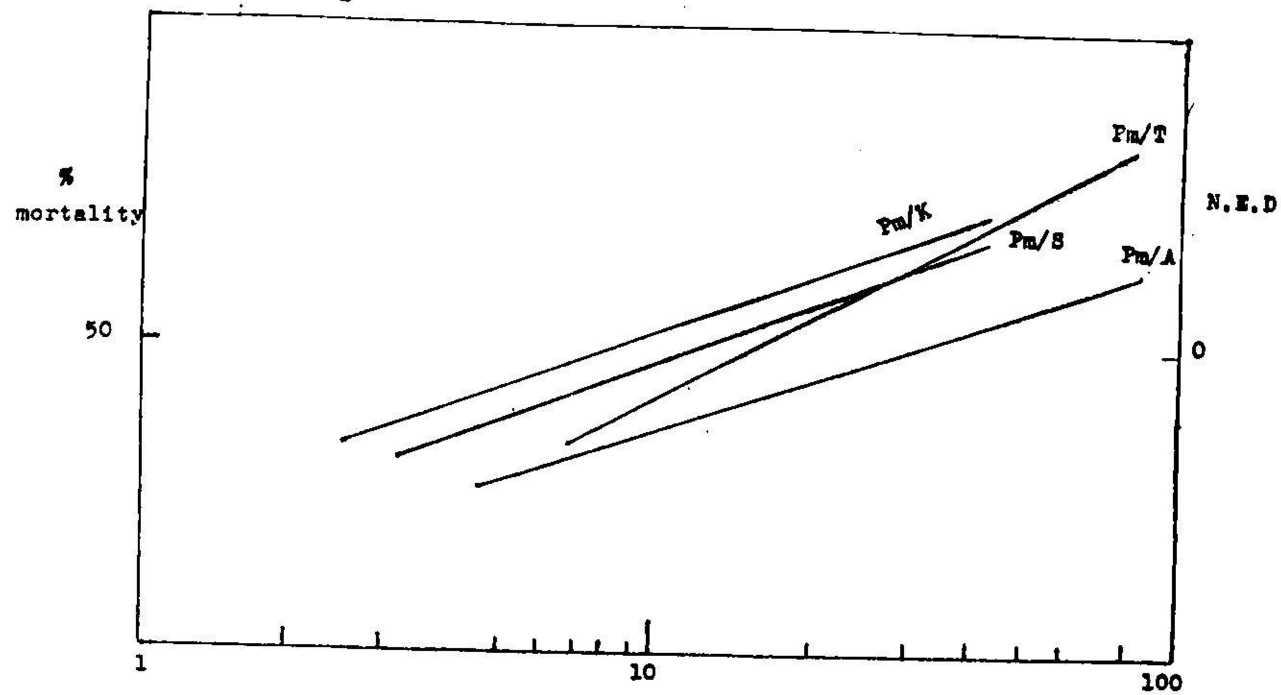
Fig. 2 a. Log (dose)/N.E.D (response)regression lines for malathion against of S.Oryzae.




M/S = malathion/silica-gel    M/T = malathion/talc

M/A = malathion/ash    M/K = malathion/kaolin.

Fig. 2 b. Log (dose)N.E.D (response) regression lines for different dust formulations of pirimiphos-methyl against S. Oryzae.

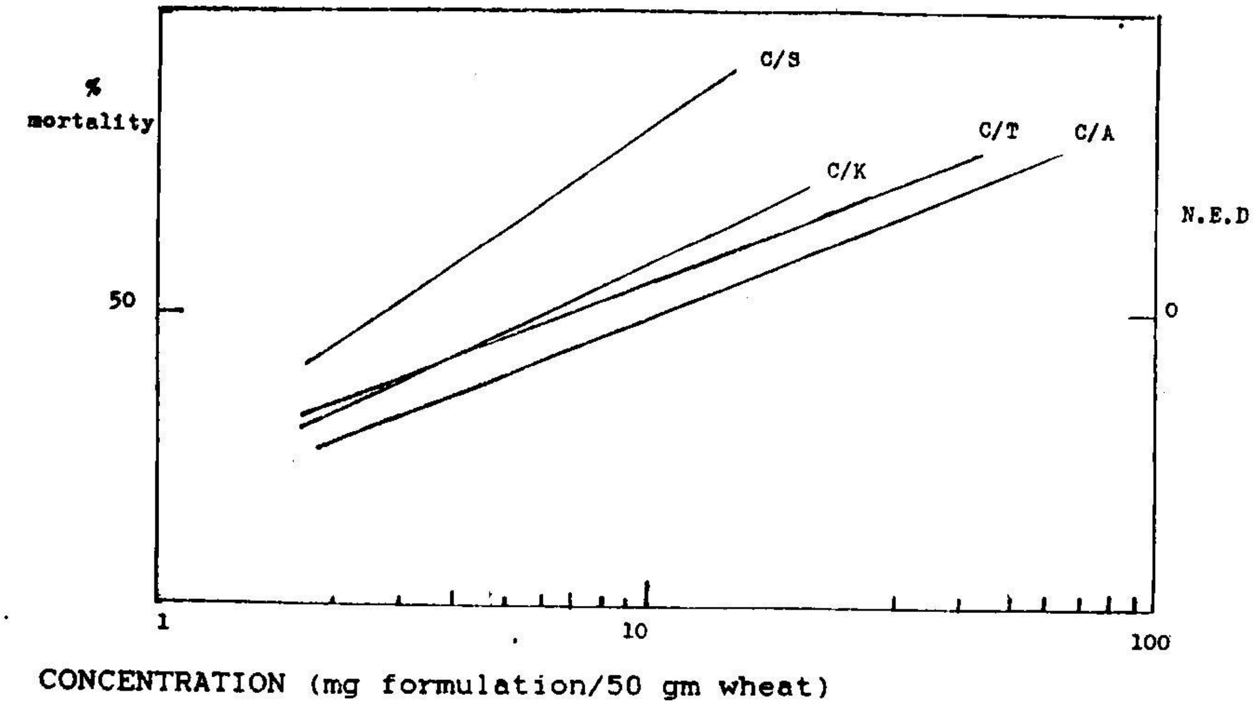



CONCENTRATION (mg formulation/50 gm wheat)

Pm/S = Pirimiphos-methyl/silica-gel. Pm/A = Pirimiphos-methyl/ash.

Pm/T = pirimiphos-methyl/talc. Pm/K = pirimiphos-methyl/kaolin.

Fig. 2 c. Log (dose)/ N.E.D.(response)regression lines for different dust formulations of cypermethrin against S.Oryae.




C/S = cypermethrin/silica gel    C/S = Cypermethrin/talc

C/A = Cypermethrin/ash    C/K = Cypermethrin/kaolin.

most effective formulation ($LC50 = 7.6$ mg/50 gm wheat)more than those formulations of malathion based on the other used carriers. $LC_{50}$ of the ash/malathion formulation at 0.1% w/w was about 7x less than talc/malathion formulation. Also, for pirimiphos-methyl, the effective one was kaolin/pirimiphos-methyl formulation.

Le Patourel and singh (1984) found that the 48 h $LC_{50}$ values of cab-o-silica/permethrin formulation at 0.1% w/w was approx imately 150 x lower than those of talc/permethrin and $LC_{50}$ of the Cab-O-Silica/cypermethrin in formulation was comparable with that of the talc/cypermethrin formulation.

It could be concluded that ash/malathion, kaolin/pirimiphos-methyl and silica gel/ cypermethrin would be useful and effective prepared dust formulations against S. oryzae. On the other hand, this will reduce the used amounts, costs, and would be more harmless to man and domestic vertebrates in the quantities applied to wheat.

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" تأثير مواد الخلط على فاعلية المبيدات الحشرية ضد حشرة سوسة الارز "

الملخص العربـــــى

أجريت عدة اختبارات لتحديد سمية المساحيق الخاملة مثل بودرة التــــلك والكاوولين والسيليكا جل والرماد وكذلك ثلاثة مبيدات هى الملاثيون والبريميفـــوس ميثايل والسيبرمثرين بنسبة ١٪ من المسحوق ومضافة لحبوب القمح على سوســة الارز ٠

اختبرت المساحيق الخاملة بتركيزات تتراوح بين ١٠ الى ٤٠٠٠ ملليجرام لكــل ٥٠ جم قمح لتحديد فاعليتهم على الحشرة وتأثيرهم على عدد الحشرات الناتجة كذلك تم تحديد الجرعة القاتلة لـ ٥٠ ٪ من الحشرة المعاملة حسب تجهيزات المبيدات المحملة علـى المواد الخاملة المختلفة بعد ٧ أيام من المعامـلة ٠

ولقد أظهرت النتائج أن السليكاجل والرماد ذات فاعلية ضد سوسة الارز ونسلها وكذلك أظهرت التجهيزات المكونة من الرماد والملاثيون والكاوليـــن والبريميفوس ميثايل وكذلك السيلكاجل وسيبرمثرين قوة تأثير عالية ضد سوسة الارز٠

وبصفة عامة يمكن الاستفادة من هذه النتائج لتقليل التلوث البيئى نتيجة لتخفيض جرعات المبيدات المختلفة الداخلة فى هذه المخاليط مع المواد الخاملة والتى أظهرت تأثير مميت على الحشرات ٠

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