

FORMULATION AND EVALUATION OF METHOMYL AS MOLLUSCICID AGAINST *Monacha cartusiana* UNDER LABORATORY AND FIELD CONDITIONS.

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ABSTRACT

Methomyl was formulated as granular formulation using Dyatomite (D) and Ca_2CO_3 (YP) as a carrier to 5, 10, 15 and 20 % (w / w a.i) against *Monacha cartusiana* on moist soil under laboratory and field conditions.

Gastrotox 5 % pellets was tested for comparison and as recommended molluscicide.

Data revealed that Methomyl (GYP) 20 and 15 % were the most effective, LC_{50} values (9.75 and 11.2 gm / m^2) followed by Gastrotox, Methomyl (GYP) 10 % and Methomyl (GYP) 5 %, LC_{50} values (2.28, 12.17 and 16.89 gm / m^2). While Methomyl (GD) (5, 10, 15 and 20 %) were the lowest treatments, LC_{50} (25, 27.95, 32.72 and 38.58 gm / m^2) respectively, under laboratory conditions.

Field trials showed that Gastrotox 5 % and Methomyl (GPY) 20 % were the most effective of the tested compounds against *M. cartusiana*. Reduction percentages were (65.93, 94.97 and 98.13) % and (82.96, 92.14 and 96.28) % for the rate of (2, 4 and 6 gm / m^2) and (15, 20 and 25 gm / m^2) respectively, followed by Methomyl (GPY) 15 % (75.04, 87.45 and 91.14) % reduction. While Methomyl (GPY) 10 % was the lowest one (58.89, 69.05 and 85.40) % reduction.

INTRODUCTION

Land snails are becoming a serious agricultural animal pest in Egypt especially in the northern coastal area. These animals were recorded with a relatively high population density on majority of economic crops and causing great damage to all plant parts. (El-Okda, 1980 and Zedan, 1999).

Molluscicides directed against terrestrial gastropods are only occasionally delivered as sprays or dusts but are more usually deployed in baits (Barker, 2002). Methomyl appeared highly effective against terrestrial gastropods as spray or wheat bran bait only in the most review *a.i* Mortada, (2002), Daoud, (2004), Ismail, *et al.* (2005) and Zedan, *et al.* (2006).

Numerous efforts are devoted to control terrestrial mollusca. Until recently no chemicals had been reported to be more effective and specific against land snails than Metaldehyd. Methomyl gave high effect against land snails as a poisonous baits than spray methods, but bait methods don't exceed 10 % population reductions (Crowell, 1967).

Gastropods usually occur in moist regions or during long periods of damp weather, Methomyl are little affected by environmental conditions and their toxicity increases in humid surrounding so that they are very suitable to gastropods (Davidson, 1962).

Therefore, the present work aimed to evaluate the molluscicidal activity of Methomyl granular formulated against *Monacha cartusiana* snails under laboratory and field conditions.

MATERIALS AND METHODS

Pesticides used :

Methomyl 90 % WP, S-methyl-N-[(methyl carbamoyl) oxy] thioacitimidate.
(Insecticide).

Gastrotox 5 % (Metaldehyde) Ready bait molluscicide. C-2, C-4, C-6, C-8
-tetramethyl-1,3,5,7 tetraoxocane (IUPAC).

Carriers :

Diatomite (D.) (12 / 25 mesh)

Calcium carbonate (yellow powder (YP) (12 /25 mesh).

Sticker :

Local Phenol formaldehyde resin.

Surface activity (PKa) :

Surface activity of carrier was estimated according to Maline *et al.* (1956) methods using Hammett indicators. Diatomite gave PKa <3.3 and > 1.5 while PKa for Calcium carbonate > 3.3. (Said, (1980)) .

Methomyl granules preparation:

Spray impregnation technique of Furnidge (1972) was used one gram of the sticker was dissolved in 20 ml acetone and sprayed on 99 gm of the deactivated carrier, then rotated for 10 minutes to achieved a homogenous and dray sample. The required amount of methomyl 90 % WP to obtain 5, 10, 15 and 20 % (w / w a.i) granular formulations were prepared and dissolved in ethyl alcohol and sprayed on the carrier then rotated and left to dray. (Said, (1980) and Zedan, (1999)) .

Tested animals:

Specimens of *Monacha cartusiana* snails were collected during spring 2006 from fields cultivated with clover in El-Dakahlia Governorate. Adult snails with a similar shell size were chosen and acclimation in the laboratory conditions for two weeks and fed on fresh lettuce leaves (Mortada, 2002) .

Laboratory experiments:

Methomyl granules (Diatomite) (MGD) (5, 10, 15 and 20 %) , methomyl granules (Yellow powder) (MGYP) (5, 10, 15 and 20 %) and Gastrotox 5 % were tested against *M. cartusiana* adults as dispersion on moist soil with concentrations of (5, 10, 15, 20 and 25 gm / m²) , (5, 10, 15, 20 and 25 gm / m²) and (2, 4 and 6 gm / m²) respectively.

Ten adult snails were placed in plastic boxes (24 × 16 ×10 cm.)filled with clay soil at depth of 5 cm then, soil moisture was adjusted to 80 – 90 % of field capacity and remoistened as required to kept snails active. Granules of the tested compounds were dispersed on soil surface at the previous concentrations. Three replicates were used for each treatment and control was free from any pesticides. The boxes were closed by its cover which contained a fine pores. Replicates were checked 1, 3, 5, and 7 days after application.

Field experiments:

Field experiments were carried out at Aga district El-Dakahlia Governorate during March, 2006. The methomyl granular formulated that exhibited high efficacy in the laboratory tests were applied in a heavily

infested fields with *M. cartusiana*. MGYP 10, 15, 20 % and Gastrottox 5 % were tested at the rate of (15, 20 and 25 gm / m²) and (2, 4 and 6 gm / m²) respectively. The field was irrigated three days before treatment. Alive snails per 50×50 cm² were recorded in check and treatments area before application. Each concentration was replicated three times. Other three replicates were left without pesticides as control treatment. The pesticides were dispersed on soil surface. Number of alive snails were counted in each replicate after 3, 5, 7, 10, 14 and 21 days of application.

Statistical procedure:

Mortality percentages were estimated and corrected for natural mortality according to Abbott's formula (1925), then subjected to probit analysis by Finney's method (1971). Reduction percentages in field were calculated according to formula of Henderson and Tilton (1955). Data were statistically analyzed using F test.

RESULTS AND DISCUSSION

Laboratory experiments:

Molluscicidal activity of methomyl granules formulated MGYP and MGD were tested against *M.cartusiana* snails using granules dispersion technique on moist soil comparison with Gastrottox as molluscicide recommended.

Table (1): Molluscicidal activity of Methomyl GYP against *M. cartusiana* snails on moist soil under laboratory conditions.

| Compounds | Rate gm/m ² | Total Dead snails | % Mortality |
|----------------|------------------------|-------------------|-------------|
| MGYP 5 % | 10 | 9 | 30 |
| | 15 | 11 | 36.66 |
| | 20 | 18 | 60 |
| | 25 | 21 | 70 |
| MGYP 10 % | 10 | 12 | 40 |
| | 15 | 18 | 60 |
| | 20 | 23 | 76.66 |
| | 25 | 28 | 93.33 |
| MGYP 15 % | 10 | 13 | 43.33 |
| | 15 | 20 | 66.66 |
| | 20 | 28 | 93.33 |
| | 25 | 30 | 100 |
| MGYP 20 % | 10 | 15 | 50 |
| | 15 | 24 | 80 |
| | 20 | 29 | 96.66 |
| | 25 | 30 | 100 |
| Gastrottox 5 % | 2 | 11 | 36.66 |
| | 4 | 28 | 93.33 |
| | 6 | 30 | 100 |

MGYP : Methomyl granules yellow powder

Data in Table (1) revealed that MGYP 20 % was the most effective one recording 50, 80, 96.66 and 100 % mortality and LC₅₀ value was 9.75 gm / m² for rate of 10, 15, 20 and 25 gm / m² respectively, followed by MGYP 15 %, Gastrotax 5 %, MGYP 10 % and MGYP 5 % mortality percentages were (43.33, 66.66, 93.33 and 100 %), (36.66, 93.33 and 100 %), (40, 60, 76.66 and 93.33 %) and (30, 36.66, 60 and 70 %) and LC₅₀ values were 11.2, 2.28, 12.17 and 16.89 gm / m² for the previous granules formulation respectively.

Also, data in Table (2) indicated that Gastrotax was the most effective one recording 40, 90 and 100 % mortality for rate of (2, 4 and 6 gm / m²) respectively, and LC₅₀ was 2.24 gm / m². while MGD 20 %, MGD 15 %, MGD 10 % and MGD 5 % appeared to be a weak molluscicidal activity compared with Gastrotax or MGYP where its mortality percentages were (16.66, 26.66, 36.66 and 53.33), (10, 23.33, 30 and 46.66), (6.66, 16.66, 26.66 and 36.66) and (6.66, 6.66, 23.33 and 30) % respectively, and LC₅₀ values of 25, 27.95, 32.72 and 38.58 gm / m² for formulation of MGD.

Table (2): Molluscicidal activity of Methomyl GD against *M. cartusiana* snails on moist soil under laboratory conditions.

| Compounds | Rate gm/m ² | Total Dead snails | % Mortality |
|---------------|------------------------|-------------------|-------------|
| MGD 5 % | 10 | 2 | 6.66 |
| | 15 | 2 | 6.66 |
| | 20 | 7 | 23.33 |
| | 25 | 9 | 30 |
| MGD 10 % | 10 | 2 | 6.66 |
| | 15 | 5 | 16.66 |
| | 20 | 8 | 26.66 |
| | 25 | 11 | 36.66 |
| MGD 15 % | 10 | 3 | 10 |
| | 15 | 7 | 23.33 |
| | 20 | 9 | 30 |
| | 25 | 14 | 46.66 |
| MGD 20 % | 10 | 5 | 16.66 |
| | 15 | 8 | 26.66 |
| | 20 | 11 | 36.66 |
| | 25 | 16 | 53.33 |
| Gastrotax 5 % | 2 | 12 | 40 |
| | 4 | 27 | 90 |
| | 6 | 30 | 100 |

MGD : Methomyl granules Diatomite

Data in Table (3) showed that LC₅₀ , LC₉₀ and toxicity index for all Methomyl granules formulations compared with Gastrotax against *M.cartusiana* whereas Methomyl granules can be arranged in order descending according to their toxicity index (molluscicidal activity) as follows: MGYP 20 %, MGYP 15 % MGYP10 % MGYP 5 %, MGD 20 %, MGD 15 % MGD 10 % and MGD 5 % with values of 22.54, 20.37, 18.74, 13.50, 9.12, 8.16, 6.97 and 5.91 % respectively.

Table (3): LC₅₀, LC₉₀ and Toxicity index of Methomyl granules formulation in comparison with Gastrotox against *M.cartusiana* under laboratory conditions.

| Compounds | LC ₅₀ | | | LC ₉₀ | | | Slope and variance | Toxicity Index |
|--------------|-------------------------|-------|--------|-------------------------|-------|---------|--------------------|----------------|
| | at 95 % fudicial limits | | | at 95 % fudicial limits | | | | |
| | value | lower | upper | value | lower | upper | | |
| Gastrotox 5% | 2.28 | 1.89 | 2.61 | 3.75 | 3.26 | 4.81 | 5.93± 0.99 | 100 |
| MGYP 20 % | 10.12 | 7.60 | 11.65 | 21.26 | 16.57 | 66.92 | 3.78± 1.33 | 22.54 |
| MGYP 15 % | 11.2 | 8.70 | 12.83 | 20.15 | 16.98 | 30.41 | 5.02± 1.23 | 20.37 |
| MGYP 10 % | 12.17 | 9.35 | 14.14 | 25.62 | 21.07 | 39.22 | 3.96± 0.87 | 18.74 |
| MGYP 5 % | 16.89 | 13.42 | 21.49 | 49.04 | 32.13 | 217.0 | 2.76± 0.81 | 13.51 |
| MGD 20 % | 25.00 | 19.87 | 53.69 | 78.22 | 42.25 | 1317.0 | 2.58± 0.85 | 9.12 |
| MGD 15 % | 27.95 | 22.00 | 63.61 | 78.08 | 43.25 | 951.57 | 2.87± 0.91 | 8.16 |
| MGD 10 % | 32.72 | 24.51 | 113.86 | 90.78 | 46.67 | 2421.71 | 2.89± 0.98 | 6.97 |
| MGD 5 % | 38.58 | - | - | 108.09 | - | - | 2.89± 1.07 | 5.91 |

Field experiments:

Gastrotox 5 % pellet and MGYP which prepared at concentrations of 10, 15 and 20 % w / w were applied against *M.cartusiana* snails using dispersion technique on moist soil during March 2006 in orchard, Aga, district El-Dakahlia Governorate. Table (4) showed that the initial kill after 3 days and average of percent reduction after 21 days for Gastrotox 5 %, MGYP 20 %, MGYP 15 % and MGYP 10 % were [(42.19, 74.43 and 83.35) and (65.93, 94.97 and 98.13)], [(68.87, 74.42 and 80.97) and (82.96, 92.69 and 96.26)], [(51.21, 64.56 and 70.52) and (75.04 , 87.45 and 91.14)] and [(36.95, 53.19 and 62.57) and (58.89, 69.05 and 85.40)] % reduction respectively.

Table (4): Efficacy of Methomyl granules and gastrotox against *M.cartusiana* infesting Orchards during spring 2006 at Aga district.

| Compounds | Rate gm / m ² | I.K * after 3 days | Residue ** after 21 days | Average |
|--------------|--------------------------|--------------------|--------------------------|---------|
| Gastrotox 5% | 2 | 42.19 | 65.93 | 54.06 |
| | 4 | 74.43 | 94.97 | 84.70 |
| | 6 | 83.35 | 98.13 | 90.74 |
| MGYP 20 % | 15 | 68.87 | 82.96 | 75.91 |
| | 20 | 74.43 | 92.69 | 83.56 |
| | 25 | 80.97 | 96.26 | 88.61 |
| MGYP 15 % | 15 | 51.21 | 75.04 | 63.12 |
| | 20 | 64.56 | 87.45 | 76.00 |
| | 25 | 70.52 | 91.14 | 80.83 |
| MGYP 10 % | 15 | 36.95 | 58.89 | 47.92 |
| | 20 | 53.19 | 69.05 | 61.12 |
| | 25 | 62.57 | 85.40 | 73.98 |

* I.K : Initial kill after 3 days.

** Residue : Mean of % reduction after 21 days post treatment.

In general, field trails showed that Gastrotax was the most effective one and closed with MGYF 20 % followed by MGYF 15 % while MGYF 10 % was the least .

Generally, these results are in harmony with those reported by many authors who applied these compounds against terrestrial gastropods a.i Ghamry, *et al.* (1993) showed that Metaldehyde as a spread was the most effective one against *M.cartusiana* followed by Methiocarb, Thiocarb, Syanophos and Monocrotofos. Mortada, (2002) reported that Metaldehyde was the most toxic followed by Carbofuran and Methomyl while Carbosulfan was the least toxic one against *Deroceras reticulatum* slugs as poisonous baits. Daoud, (2004) reported that Neomyl exhibited the highest toxic action against *M.cartusiana* and *E.vermiculata* snails followed by Vertimec, Marshal Dursban and Curacron under laboratory conditions. Ismail, *et al.*(2005) revealed that Metaldehyde and Carbosulfan compound were highly efficacy against *M. cartusiana* under field conditions while the Organophosphorus compounds appeared to be the least effect.

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تجهيز وتقييم محبيبات الميثوميل لمكافحة قواقع البرسيم الزجاجي *Monacha cartusiana* تحت الظروف المعملية والحقلية.

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تم تجهيز محبيبات الميثوميل بتحميلها على الدياتوميت و كربونات الكالسيوم بتركيزات ٥ ، ١٠ ، ١٥ ، ٢٠ % من المادة الفعالة لمكافحة قواقع البرسيم الزجاجي *Monacha cartusiana* على تربة مبللة معمليا وحقليا مقارنة بمبيد الجاستروتوكس والمخصص لمكافحة القواقع الأرضية وذلك خلال موسم الربيع ٢٠٠٦ م .

أوضحت النتائج المعملية أن محبيبات الميثوميل على الدياتوميت ٢٠ ، ١٥ % كانت أكثر المحبيبات فاعلية حيث كانت LC_{50} (٩,٧٥ ، ١١,٢ جم / م^٢) يليها مبيد الجاستروتوكس ، الميثوميل محبب ١٠ % ، ميثوميل محبب ٥ % حيث كانت LC_{50} (٢,٢٨ ، ١٢,٧ و ١٦,٨٩ جم / م^٢) على الترتيب ، بينما كانت محبيبات الميثوميل على كربونات الكالسيوم أقلهم تأثيرا .

أظهرت التجارب الحقلية لمبيد الجاستروتوكس ومحبيبات الميثوميل على الدياتوميت (٢٠ ، ١٥ و ١٠ %) أن مبيد الجاستروتوكس أعلاهم نسبة خفض لتعداد القواقع يليه محبيبات الميثوميل ٢٠ ، ١٥ ، ١٠ % حيث كانت نسبة الخفض (٦٥,٩٣ ، ٩٤,٩٧ و ٩٨,١٣ %) ، (٨٢,٩٦ ، ٩٢,٦٩ و ٩٦,٢٦ %) ، (٧٥,٠٤ ، ٨٧,٤٥ و ٩١,١٤) و (٥٨,٨٩ ، ٦٩,٠٥ و ٨٥,٤٠ %) بعد ٢١ يوم للتركيزات (٢ ، ٤ ، ٦ جم / م^٢) للجاستروتوكس و (١٥ ، ٢٠ ، ٢٥ جم / م^٢) لمحبيبات الميثوميل على الترتيب .