Minufiya J. Agric. Res. Vol.36 No. 1: 109 - 124 (2011) **"http://www.mujar.net"**

EFFICIENCY OF NATURAL PLANTS FINE DUSTS ON THE FITNESS COMPONENTS OF POTATO TUBER MOTH *phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae)

1) Effect of Kamphor and citrus's fine dusts.

H. A. Mesbah[(1)], Magda. B. El-Kady [(1)]; Randa. M. Gouda [(2)] and Gihan. M. Ibrahim [(1)]

1- Plant Protection Dept., Fac. of Agric., Saba Basha, Alex., Univ. Egypt.

2– Plant Protection Research Institute, El-Sabaheia, Agric. Res centre Alex. Egypt

(Received: Aug. 18, 2010)

ABSTRACT: ***The effect of potato tubers treatment with fine dusts of, Eucalyptus globules, Citrus aurantifolia and Citrus sinensis, and Talc powder on the fitness components of raised generations of potato tuber moth (PTM), phthorimaea operculella. Results showed a direct as well as accumulative delayed effect of tested plants fine dusts, either alone or admixed with talc powder in progressive dilutions from 5 % up to 20 % w/w on the viability of developing immatues and potentiality of adult moths.***

In comparison to the untreated insect, the revealed effects of each of tested crud plants fine dusts or talc powder alone and / or their progressive dilutions (w/w) on the inspected parameters of fitness components, had been detected and could be explained briefly as gradual significant shortening of life span of both sexes, prolongation of larval and pupal durations, reduction in the number of raised pupae and increase of the malformed ones, sharp decrease in the rate of emerged moths, deposited eggs; and developing immatures.

In concern to the lower used dilutions of tested plant fine dusts from 5% to 20% w/w, the complete inhibition of reproductive potential of both adult sexes, the going on metamorphic development (rate of deposited & hatched eggs, and raised immatures of the following generation) after the treatment of parent one, had been revealed as distinct failure of a) (F_1) development after former treatment with the lower prepared dilution of 5% of talc powder & each of tested E. globules and C. aurantifolia plant fine dusts. Where, the fewer number of emerged moths were unviable, weak, sterile and died before induction the F_1 progeny. b) (F_2) development due to the former treatment with each of talc powder, C. sinensis fine dusts alone or their prepared dilutions of 5& 10% (w/w); which gave sterile moths unable to induce the F_2 progeny.

Key Words***: Kamphor (Eucalyptus globules), (Citrus aurantifolia and Citrus sinensis), potato tuber moth, (phthorimaea operculella), genetic control.***

INTRODUCTION

Potato, *Solanum tuberosum* L.(Solanaceae) is the fourth widely produced food crop worldwide. In Egypt potato ranks second after cotton as an effective cash crop.

In field condition potato plants and tubers are attacked by many pests. Amongest, the potato tuber moth (PTM) *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae), is the common serious cosmopolitan insect-pest of stored potato tubers that infests potatoes outdoors in the worm climates, as well as other solanaceous crops.

Several investigators recognized it as the utmost serious and destructive insect pest of potato due to the sever damages it causes by the high occurring levels of infestation. (Arnone *et al*., 1988, Soeriaatmadja, 1998, Lal, 1990. Numerous workers reported on the indiscriminate use of insecticides as disadvantageous due to the greater increased pollution effects.

In Egypt, this insect-pest is utmostly injurious. The newly hatched larvae on foliage usually begin feeding between the surfaces of a leaflet, creating a small hollowed out batches, sometimes make shelters by folding the infested leaflets and fastening them together with silk. Larvae may also bore into petioles or stems, and oftenly move to tubers and creat deep black tunnels about ⅛ inch (3mm) in diameter through the flesh of the tubers. Infestation occurs mostly in the first growing season (January to May), when pressure is heavy, field losses can be 30 %. The insect is considered also as a serious pest of potato tubers in storage. Storage losses vary from 40 to ⅛ depending on stores condition, potato cultivar, and locality (Zaghloul, 1993), losses can be 100 % within 90 days.

During the second half of the last century, pesticidal applications were considered to be the only tool to suppress pest infestation. the extensive and unwise use of chemicals led to environmental pollution that caused many problems related to the ecosystem, though in continous search for new pest control agents, plants are considered one of the richest soueces (Attallah et al. 1986 Magda *et al*.1990; Tayeb *et al*., 1993 and Mesbah 2001). Some plant oils are also effective as control agents (Sharaby, 1999). So that, the most available recent promising alternative method is the use of extracted natural compounds from different plant organs, i.e., roots, shoots, flowers or / and fruits and seeds (Lui *et al.,* 1990; and Jagannaah and Nair, 1992.

In particular, insecticides of plant origin are safe and less hazardous to the ecosystem. Therefore the objective of this search is to study the impact of certain prepared plant fine dusts/talc powder dilutions (w/w) on the fitness components of the parental and following generations of *P.operculella* for its proper management.

MATERIALS AND METHODS

1. Stock Culture of Potato Tuber Moth

Infested potato tubers were collected and kept with clean tubers in cubic glass cages. On its floor a thin layer of saw dust (3 cm thickness) was spread. Cages were covered with muslin. Rearing of the insect *P. operculella* was successfully performed for several generations under laboratory higrothermic conditions of 24 ± 2 °C and 70 ± 5 % R.H. Usually, the eggs are laid around the buds of tubers and the hatching larvae mine inside them. Pupation took place outside the tuber in saw dust layer. After adults emergence 5% sucrose solution was provided, (Assem, 1966).

I) The used material:.

Ia) Natural plant fine dusts:

The leaves of three used plant species camphor (*Eucalyptus globules*), Limon (*Citrus aurantifolia*), orange (*Citrus sinensis*), were collected, dried in the open air and thereafter, put in an electric oven at 60°C till complete dryness. Then these dried leaves of each plant species were ground by means of electric mill till the attainment of their fine powder. The main chemical constituents of each tested plant are as follow.

***Eucalyptus globules*: Flavonoids Eucalyptrin, hyperoside, quercetin, quercitrin, rutin, volatile oils, Eucalyptol, monoterpenes, sesquiterpenes, Tannis and associated acids, resins and waxes.**

***Citrus aurantifolia*: d- limonene, d-pinene, camphene, terpinene, linalool, hendecanal, terpineol, linalyl acetate and cadinene.**

***Citrus sinensis*: d-limonene, decylic, octylic, monylic, dodecylic, aldehdes; citral, linalool, d-l-terpineol and methyl anthranilate.**

Ib) Bioassay test.

For bioassay test equal amounts of potato tubers were weighted (500 gr.) placed in 1 litter glass jars and dusted with the different prepared concentrations (5%, 10%, 20%, 30% and 50%) by mixing the attained fine dust of each plant species with Talc powder, Talc powder; and/or fine dusts of each plant species alone. The treated tubers were shacked thoroughly to ensure good admixing by the tested fine dusts.

Two pairs of the emerging adults of stock culture were released in each jar including the treated tubers, covered with muslin, and provided with a hanged piece of soaked cotton pad in 5% sucrose solution. Treatments were tricely replicated. No ticeably, in most of tested fine dust / *talc powder* dilutions. The higher concentrations of 30 & 50% (w/w) indicated the distinet failure of (F_1) development post parent generation treatment, therefore the

results of present work included only the revealed effects of tested lower concentrations from 5% to 10% . w/w for tested fine ctusts.

II Tested mineral – dust – talc powder

For bioassay test, treatment were tricely replicated. In each replicate the fixed weight of potato tubers (500 gm.) was placed in 1 liter jar and dusted by 10 gr. Of Talc powder for 1 minute. Later, two couples of the emerging adults (2♀, 2♂) of stock culture were released in the jar, and provided with a hanged piece of soaked cotton pad in 5% sucrose solution.

RESULTS AND DISCUSSION

Effect of potato tuber treatment with mixture of admixed *Eucalyptus globules* /Talc *powder* fine dust 5% (w/w).

The illustrated data in Table (1) declear the detected effect of performed dusting of potato tubers on the fitness components of treated insects of parent moths; duration, survival and malformation of raised immatures, and adults emergence of following generation. The longer life span of female moths was recorded in control treatment (18.7 ± 0.88 days) in comparison to those treated with tested (*E.globules* / Talc Powder) fine dust 5% (w/w), which showed shortened period of moths longevity (12.0 ± 0.58 days).

The same trend was also observed for male moths (11.0 ± 1.16 days) in control treatment, versus 8.0± 0.58 days for treated ones (Table 1).

Moreover, the obtained results showed that the duration of treated insect from the egg up to pupation was prolonged a more extent and lasted from 14.0 ± 0.58 in control treatment up to 17.33 ± 0.88, 17.67 ± 0.33 and 26.0 ± 0.58 days in the treatments of *E. globules* crude fine dust, Talc powder and 5% (w/w) *E. globules* / Talc Powder mixture, respectively (Table1). A same trend of results was also recorded for the calculated durations of raised pupae post treatment with *E. globules* / Talc Powder fine dust. 5% (w/w), Talc powder and crude *E. globules* fine dust (11.33 ± 5.70 – 14.33 ± 1.20 & 14.33 ± 0.88 days, in respect), versus the untreated ones which gave a shorter durational period of 6.67 ± 0.33 days. The highest average number of resulted pupae (87.0 ± 0.66) recorded in control treatment was ratherly decreased up to 4.0 ± 2.31 post treatment with *E. globules* / Talc Powder fine dust 5% (w/w) (Table1). Also; the application of crude *E. globules* fine dust and/or talc powder alone Talc Powder to great extent, decreased the rates of resulted pupae (14.0 ± 0.58 & 12.33 ± 1.45, respectively). The lowest rate of moths emergency was observed also for the tested fine dust mixture of *E. globules* / Talc Powder 5% (w/w) (0.33 ± 0.33). The fewer number of emerged moths in these treatment were weak, unviable, sterile and died before the induction of the F_1 progeny (Table 1).

Table 1

That could be explained by the efficient treatment of potato tubers with the tested 5% w/w *E. globules* / Talc Powder fine dust, which caused more increased significant drastic effect on the fitness components of raised larvae; sequently raised the rate of malformed pupae and moths; and finally the sharp reduction of deposited viable eggs.

Also, the fewer numbers of F_1 resulted moths post parants treatment with crude *E. globules* and Talc Powder fine dusts alone were distinctly weak and unviable, in comparison to the untreated one and the duration of the fewer number of (F_1) hatched larvae was longer in case of *E. globules* fine dust (18.0 ± 7.02 days) than that recorded for the untreated larvae (14.0 ± 0.58 days). Whereas, Talc Powder treatment showed the complete failure of (F_1) larval development and consequently the following developmental stages of (F_1) PTM (Table 1). That distinctly observed failure of (F_1) development at both the initiated treatmental applications of Talc powder and/or crude *E. globules* fine dusts could be attributed to the so faster effect of moth treatments on the viability and fertility of both influenced sexes throughout the period of parent generation (p) development which caused the revealance of unprofitable metamorphic effects at the beginning of 1^{st} generation and complete elimination of moth emergence.

Effect of treatment with the mixture of 5% (w/w) Talc powder and *Citrus aurantifolia* fine dust.

The illustrated data in Table (2) declear the longer life span of untreated control female and male moths which averaged 18.67 ± 0.88; 11.0 ± 1.16 days, respectively. While, in the other initiated treatments, moths lasted more or less shorter longevities according to the performed treatment and amounted to 5.0 ± 0.58, 7.0 ± 1.16 and 10 ± 0.58 days for females and 1.67 ± 0.33, 5.0 ± 1.58 and 8.0 ± 0.58 days for males in case of treatments of Talc powder, *C. aurantifolia* and their lower tested concentration of 5% w/w, respectively.

The reverse trend of results was revealed for the duration periods from the egg to the pupae, which was greatly prolonged up to 31.67 ± 0.88 days in the treatment of 5% (w/w) *C. aurantifolia* / Talc powder fine dust. That value was somewhat decreased to 17.67 ± 0.33 and 25.0 ± 1.55 days in case of Talc Powder and *C. aurantifolia* fine dust treatments alone, while it comprised a shorter period of 14.0 ± 0.58 days in the untreated control (Table 2) for the raised pupae a same trend of comparative longer duration periods of 13.0 ± 0.58; 14.33 ± 1.20 and 17.0 ± 0.58 was observed in case of treatment with *C. aurantifolia* fine dust, Talc powder and their 5% w/w mixture, compared to a shorter durational period of 6.67 ± 0.33 days for untreated control. The highest percentage of dead pupae (24.6 ± 8.73) was recorded for the treatment of *C. aurantifolia* fine dust alone, versus the lower one of (7.97 ± 0.71) for untreated control, which sequently gave the highest average percentage of resulted pupae (87.0 ± 6.66) (Table 2).

Table 2

In addition, the more efficient treatment of Talc powder greatly reduced the number of emerged moths from 80.00 ± 5.77 in control treatment up to 5.67 ± 1.45 only, while, treatment with *C. aurantifolia* fine dust or its mixture with *talc powder* at a rate of 5% (w/w) merely gave the some lower averages numbers of emerged moths 7.76 ± 1.45 & 7.33 ± 0.88, respectively (Table 2)

Obviously, from the illustrated data in Table 2, it could be also seen that this lowest tested concentration of 5% w/w; Talc powder and/or *C. aurantifolia* fine dust alone, drastically affected the studied biological characters of the insect.

Whereas, the fewer number of emerged moths were unviable, weak, sterile and died before induction of the (F_1) progeny (Table 2). Moreover, that determined failure could be attributed to the rapidly going on drastic effects on the viability and fertility of both influenced sexes throughout the period of parent generation (P) development, which induced unprofitable developmental effects at the beginning of 1st generation.

Effect of potato tuber treatments with the mixtures of Talc powder and *Citrus sinensis* fine dust.

The exhibited results in Table (3) elucidate the prolonged period of female and male life span (18.67 ± 0.88 & 11.0 ± 1.16 days, in respect in the untreated control moths, in comparison to a more or a less shorter periods in the other initiated treatments according to the tested material and treatmental concentration. Whereas the treatment with the fine dusts of Talc powder followed by *Citrus sinensis* alone, significantly shortened the calculated averages longevities of moths up to 5.0 ± 0.85 days for female and 1.67 ± 0.33 days for male, compared to the case of their tested mixtures at 5% and 10% w/w (15.0 ± 1.16 & 12.0 ± 1.16 days for female and 10.33 ± 0.33 and 8.0 ± 0.58 days for male, respectively). (Table 3).

The reverse trend of results was revealed for the greatly prolonged duration period from the egg to the pupae in the carried out treatments of admixed *C. sinensis* fine dust & Talc powder at 5% and 10% (w/w) (26.67 ± 0.88 & 32.33 ± 1.45 days respectively); somewhat decreased up to 17.67 ± 0.33 & 21.0 ± 0.58 days in case of talc powder and *C. sinensis* fine dust alone, while it was the shortest (14.0 ± 0.58 days) in the untreated control treatment (Table 3).

The same trend of results was recorded for the calculated durations of raised pupae. The shortest durational period of pupae (6.67 ± 0.33 days) was recorded in untreated control; more prolonged up to 10.0 ± 0.58; 13.0 ± 1.16; 14.33 ± 1.20 & 15.33 ± 0.88 in case of the performed treatments of *C. sinensis* / Talc powder fine dust mixtures at 5% & 10% w/w, Talc powder and / or *C. sinensis* fine dust alone. Also, the highest average number of resulted pupae (87.0 ± 6.66) in untreated control was greatly lowered up to 8.0 ± 1.16 in the treatment of 10% (w/w) *C. sinensis* / Talc powder fine dust (Table 3).

Table 3

The treatment of Talc powder alone gave the highest percentages of malformed pupae (34.44 ± 8.68) followed by that of *C. sinensis* fine dust (26.12 ± 3.99) and their mixtures of 10% & 5% w/w; while that phenomenon of malformed pupae was completely declined in the untreated control (Table 3). In all of run treatments the calculated averages percentages of dead pupae were significant. In addition, the greatly reduced number of emerged moths from 80.0 ± 5.77 in the untreated control up to 5.0 ± 0.58 moth was recorded for the treatment of admixed *C. sinensis* / Talc powder at rate of 10% w/w (Table 3). In the other conducted treatments of *C. sinensis* / Talc powder fine dust mixture at 5% w/w or Talc powder & *C. sinensis* fine dust alone, the lower numbers of emerged moths ranged from 5.67 ± 1.45 to 8.33 ± 1.45.

Moreover, the fewer numbers of emerged moths after treatment with mixed *C. sinensis* & Talc powder fine dust at concentrations of 5% & 10% w/w, and / or Talc powder alone were unviable, weak, sterile and died before the completion of the (F_1) generation (Table 4). The distinct failure of (F_1) development at each of three initiated treatments (5%, 10% w/w & Talc powder alone) could be pertained to the so faster drastic effect of Talc powder alone or admixed with *C. sinensis* fine dust on the viability and fertility of both developing sexes throughout the period of parent generation (p) development.

Furtherly, that drastic effect caused the revealance of unprofitable biophysiological effect on the developmental processes at the beginning of 2^{nd} generation (Table 4). due to the treatment of potato tubers with *C. sinensis* fine dust alone / or and significantly shortened the calculated averages longevities of (F_2) moths up to 2.33 ± 0.33 for female; 1.33 ± 0.33 days for male, respectively.

Furtherly, the drastic effect of *C. sinensis* fine dust on all the studied biological characters of (F_1) insect individuals, had been followed by a distinct failure of (F_2) development (Table 4); due to the former treatment of (p) generation with *C. sinensis* fine dust. That failure could be attributed to the cummulative effect of induced recessive leathal genes in both the influenced sexes along the following developing (F_1) generation after (p) one treatment causing apparent unprofitable effects, which appeared at the beginning of 2^{nd} generation (Table 4).

Our above cited results of evaluated natural plants fine dusts and their mixtures with talc powder were confirmed by the mentioned results in the works of numerous researchers, i.e Raman *et al*. (1987) who showed that the dried foliage of *Eucalyptus globules*, *Lantana camara* and *Mintha stachs* sp., all in the dried shredded and powder from were effective in controlling the damage of potato tuber moth in stored potatoes, along four months. Also, Lal (1987), the same auther (1988) explained that the use of *Lantana camara* and *Eucalyptus globules* leaves caused repellent effect on *Ph. operculella* and

reduced tuber damage up to 5 and 8%, respectively compared with 90% damage in untreated potatoes.

Lal (1987) investigated the effects of the leaves of *Eucalyptus globules* and *Lantana aculeate* besides, other plant species on the gelechiid *phthorimaea operculella*. He showed that the leaves of *Lantana aculeata* provided the most protection, reducing tuber damage to below 5% and sprout damage to below 3%, compared with 70% and 45%, respectively, in the untreated control. The next most effective treatment was *E*. *globules* followed by *B*. *thuringiensis*. None of the treatments had an adverse effect on germination or on the yield of subsequent crop.

Wahundeniya (1989) evaluated the effectiveness of foliage of locally available plants and insecticides against the gelechiid *phthorimaea operculella*. In the first experiment, foliage of *Lantana camara*, *Eucalyptus grandis, Psiadia ceylanica* and *chenopodium ambrosioides*; and prothiofos, pirimiphos methyl and chlorfluazuron were evaluated in an experimental store. In the second experiment, foliage of *L.camara* and *C.ambrosioides* and prothiofos and primiphos-methly were evaluated in 5 stores. Effective control of *Ph*. *Operculella* was achieved with foliage of *L.camara* and *C. ambrosioides* and pirimiphos-methyl.

Kashyap *et al* (1992) evaluated the efficacy of powdered dry leaves of *Vitex negundo, Ageratum houstonianum, Mentha longifolia*, *Cinnamomum tamela, Cannabis sativa, Lantana camara, Murraya koenigii* and *Eucalyptus* sp., and sand in controlling *Phthorimaea operculella* on stored potatoes. A 2-cm thick layer of *A.haustonianum* or *C.sativa* protected potatoes for up to 120 days. V.negundo and M.longifolia were equally effective, and only 6% infestation was observed in these treatments.

Sharma *et al* (1997) showed that the efficacy of alcohol extracts of tested plants was superior than that of other solevent's extracts in reducing egg oviposition and hatchability. The order of efficacy of these tested plant extracts was *pinus roxburghii* > Achook (a neem – based formulation) > *Eucalyptus globules* > *Murraya hoenigii* > *Lantana sp*. > *Cannabis sativa* > *Nicotiania tabacum* > *mellaphalnu* > *Mentha arvensis* > *Melia azedrach* > *Vitex negundo*.

Debnath *et al* (1998) explained that damage to stored tubers was significantly reduced following the application of dry eucalyptus leaves, and powdered sweet flag (*Acorus calamus*) rhizomes and eucalyptus leaves. Dusting healthy tubers with fine wood ash controlled in infestations for long periods the they also determined the efficacy of various control measures against potato tuber moth *Phthorimaea operculella*. They explained that damage to stored tubers was significantly reduced following the application of dry eucalyptus leaves, and powdered sweet flag (*Acorus calamus*) rhizomes an eucalyptus leaves.

Table 4

Dusting healthy tubers with fine wood ash controlled infestations for long periods, seed potatoes were adequately protected by 5% malathion dust and 1.5% quinalphos dust. Potatoes kept in gunny bags impregnated with solutions of malathion 50 Ec and azadirachtin 1400 ppm were also free of damage. Although treatment with *Bacillus thuringiensis* resulted in a low level of infestation and rotting the percentage tuber damage remained high.

Moreover, the efficiency of other tested phytochemical as crude extracts and / or fine dusts of different natural plants were explained in the works of sawan (1995), Sharma *et al*. (1997) and Mesbah *et al*. (2001).

REFERENCES

Arnone , S., S. U. A. Sonnino and B. Cirico (1988). The potato moth a new problem for agriculture in the area of viterbese. Informator –Agario., 44(25) :79-84.

Assem, A. M. (1966). Studies on vegetable leaf miners . Ph.D. Thesis. Fac. Agric. Cairo Univ., 28-38.

Attallah, E. A., S. A. Dosse and M. L. Wahba (1986). Effect of host plants on some biological aspects of the potato tuber worm Phthorimaea operculella (Zeller). Agric. Res. Revi., 59 (1): 39-97.

Debnath, M. C., J. N. Khound, S. K. Dutta and P. C. Sharma (1998). Management of potato tuber moth , *Phthorimaea operculella* (Zeller) in potato storage . J. of. Agric. Sci. Soci. of North East India ,11 (1) :55-60.

Jagannadh, V. and V. S. Nair (1992). Azadirachtin induced effects on larval pupal transformation of Spodoptera mauritia . Physio. Ento.,17(1):56-61.

Kashyap, N. P., R. M. Bhagat, DC. Sharma and S. M. Suri (1992). Efficacy of some useful plant leaves for the control of potato tuber moth , *Phthorimaea operculella* Zell. in stores . J. Entomo. Res.,16(3):223-227.

Lal, L. (1987). Studies on natural repellents against potato tuber moth ,*Phthorimaea operculella* (Zeller) in country stores . Potato-Res., 30(2): 329-334.

Lal, L. (1988). potato tuber moth ,*Phthorimaea operculella* (Zeller), in Nprth eastern Hills region and simple method for its control . Indian J. Agric. Sci., 58(2):130-132.

Lal, L. (1990). Insect pests of potato and their status in North Eastern India. Asian Potato Journal (philipines)., 1(1) :49-51.

Lui, Y. B., A. R. Alford, M. S. Rajab and M. D. Bentley (1990). Effects and modes of action Citrus limonoids against Leptinotarsa decemlieata. Phsio. Ent., 15 (1) :37-45.

Magda, El-Kady, E. H. Tayeb, H. A. Mesbah and A. A. Saad (1990). The relative efficiency of the pregnancy inhibiting hormone medroxy progesterone acetate (MPA) and an insect growth inhibitor-XRD on the greasy-cut worm *Agrotis ipsilon* (Noctuidae, Lepidoptera). Bull. Ent. Soc. Egypt. Econ. Ser., 18: 93-104.

Mesbah, H. A., E. H. Tayeb, H. A. Awad and M. A. Massoud (1991). Toxicity and joint of certain IGI_s formulations and their mixtures with five insecticides and three chemical compounds upon the cotton leaf worm *Spodopter littoralis* (Boisd.) 4th Nat. conf. of pests& Dis. of veg. Fruits in Egypt,410-423.

Mesbah, H. A., N. S. Haroum, M. B. EL-Kady and G. M. A. Ibrahim (2001). comparative evaluation of some Insecticides, Inert Dusts and Natural Plants Against the Potato Tuber Moth *Phthorimaea operculella* (Zeller) (lepidotera : Gelchiidae). Adv. Agric. Res., 6(1):119-136.

Raman, K. V., R. H. Booth and M. Palacios (1987). Control of potato tuber moth, *Phthorimaea operculella* (Zeller) in rustic potato stores. Tropical Science, 27(3) :175-194.

Sawsan, S. M. (1995). Biological effects of some natural and chemical compounds on the potato tuber moth *Phthorimaea operculella* (Zeller.) .M Sc. Thesis , Fac. of Sci. Ain Shams Univ.

Sharaby, A. (1999). Effect of orange, *Citrus sinensis*, (L.) Peel oil reproduction in *Phthorimaea operculella* (Zell.). Insect science and Its Application, 9 (2):201-204.

Sharma, D. C., S. Rani and N. P. Kashyap (1997). Oviposition deterrence and ovicidal properties of some plant extracts against potato tuber moth *Phthorimaea operculella* (Zeller) . Pesticide Research J. 9 (2): 241-246 .

Soeriaatmadja, R. E. (1998). Influence of altitude on populations and level of damage of the potato tuber moth(*Phthorimaea operculella* zeller). Buletin penelitian Horticulture, 16(3):52-57.

Tayeb, E. H., M. A. Massoud and Nagda El-Sayed (1993). Anti-ecdyson effect of garlic extract and its joint action effect with certain insect growth inhibitors (IGIs) on the formation of larval body wall of *Spodoptera littoralis* (Boids.). Com. In Sci. and Dev.Res., 43 (656): 59-80.

Wahundeniya, I. (1989). Effect of “botanicals’’ on the control of potato tuber moth, *Phthorimaea operculella* in storage. Proceedings: Integrated Pest Management. In Tropical and subtropical cropping systems ,(3): 999-1012.

Zaghloul, O. A., R. M. Bahgat, D. C. Sharma and S. M. Suri (1993). Efficiency of some useful plant leaves for the control of the potato tuber moth, *Ph.operculella* (Zeller) in stores. J. Ent. Res., 16 (3):223-227.

تقييم فاعلية مساحيق التعفير من النباتات الطبيعية علي مكونات الموائمة للاجيال المتتالية لفراشة درنات البطاطس

١- تأثير مساحيق أوراق الكافور ونوعين من أوراق أشجار الموالح

حسن علي مصباح[١] - ماجدة بهجت القاضي[١] - رندا محمد جوده[٢] - جيهان محمد ابراهيم[١]

١- قسم وقاية النبات . كلية الزراعة (سابا باشا) جامعة الاسكندرية

٢- معهد بحوث وقاية النباتات . بالصبحية . مركز البحوث الزراعية . الاسكندرية

الملخص العربي

تم تقييم بعض المواد الطبيعية التي يتوقع فعاليتها وإمكانية استخدامها في برامج المكافحة المتكامله لفراشة درنات البطاطس وقد تم دراسة تأثير معاملة تعفير درنات البطاطس بمساحيق أوراق النباتات التالية: الكافور . الليمون البنزهير . البرتقال الحلو وكذلك بودرة التلك علي مكونات الموائمة الخاصة بالأجيال المتتابعة من دودة درنات البطاطس وتم التوصل إلي نتائج محددة يمكن ايجازها فيما يلي:

حدوث التأثير المباشر أو الممتد المفعول نتيجة المعامله بمساحيق النباتات المختبرة كل علي حده أو مخلوطة مع بودرة التلك علي تطور وحيوية اليرقات والعذاري والأقتدار الحيوي للفراشات بالمقارنه مع الحشرات الناتجة من درنات البطاطس غير المعامله.

وكذلك أظهرت النتائج اتجاهات متماثله لتأثيرات المعامله بكل من المسحوث النباتي أو بودرة التلك منفرده أو بتركيزاتهم المختلفة عند الخلط علي المقاييس البيولوجية المختبرة أثناء تطور ونمو جيل الأباء المعامل والأجيال التالية له (بعد المعامله) والتي يمكن توضيحها باختصار فيما يلي:

١- القصر التدريجي المعنوي في فترة حياه الحشرة الكامله لكلا الجنسين.

٢- التطويل التدريجي في فترة نمو الطور اليرقي وطور العذراء.

٣- انخفاض في عدد العذاري الناتجة مع زيادة في عدد العذاري المشوهه.

٤- انخفاض حاد في عدد الفراشات الناتجة ومعدلات وضع البيض.

٥- بتوالي الأجيـاب انتهـي الأمـر بظهـور أعـداد بسيطة أو نـادرة مـن الأطـوار غيـر الكاملـه المنخفضة الحيوية أو الضعيفة والتي أعقبها التوقف النهائي لدودة الحياة.

وقد أختلفت مواعيد التوقف النهائي لدودة الحياة في الأجيال المتتالية بعد جيل الأباء المعامل، طبقا لنوعية مسحوق النبات المستخدم أو بودرة التلك بصورة منفردة أو نتيجة إستخدام تخفيفات من مخاليطهم مع بعض كما يلي:

- **في معظم الحالات التوقف النهائي لدورة الحياة حدث في حالـه استعمال التركيزات العالية المجهزة من خلط بودرة تلك مع مسحوق نباتي تم اختياره والتي تراوحت فيما بين ٣٠٪ و٥٠٪ (وزن / وزن) وذلك في نهاية جيل الأباء المعامل.**
- **حسب تركيز التخفيفات المنخفضة والمختبرة لكل مسحوق نباتي (من ٥٪ إلي ٢٠٪ وزن / وزن) وكذلك المكونات الكيمائية لكل نوع، والتثبيط الكامل للاقتدار التناسلي لكلا الجنسين وكذلك تدهور عمليات التطور التحويلي لطور البيضة أو الأطوار غير الكاملة في الأجيال المتتابعة (المتعاقبة) بعد معاملة جيل الأباء . أوضحت الفشل الواضح لدورة الحياة عند:**

▪ **الجيل الأول (F_1) نتيجة المعاملة بالتجهيزات المخففة والمنخفضة التركيز (٥٪) لكلا من الكافور والليمون البنزهير مع بودرة التلك.**

▪ **الجيل الثاني (F_2) نتيجة المعاملة بالتجهيزات المخففة والمنخفضة التركيز (٥-١٠٪) لمساحيق كل من البرتقال مع بودرة التلك.**

▪ **الفشل الكامل لتطور ونمو كل جيل من الأجيال السابق ذكرها يمكن أن يعزي إلي التأثير التراكمي والممتد المفعول للجينات المميتة المتنحية في كلا الجنسين المتأثرين بالمعاملة خلال الفترات الممتدة علي مدي الأجيال التالية والمتعاقبه بعد جيل الأباء المعامل والتي تسببت في حدوث تأثيرات ضاره ظهرت جليا عند بداية كل جيل منهم.**

Table (1): The delayed effect of prepared *E.globules* fine dust and Talc powder mixture (5% w/w) on the fitness components of tested generations of *Phthorimaea operculella*.

Treatments	Moth longevity (days)		Larval duration (days)▪	Pupal duration (days)	Number of resulted Pupae	Number of malformed Pupae		Number of dead pupae		Moth emergency	
	♀♀ $\bar{X} \pm S\bar{X}$	♂♂ $\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$
Parent generation											
E.globules / talc powder (5%)	12±0.58 11-13	8.0±0.58 7-9	26.0±0.58 25-27	11.33±5.70 6-18	4.0+2.31 0-8	1.33±0.67 0-2	25.0±14.43 0-50	2.33±1.45 0-5	37.5±19.10 0-62.5	0.33±0.33 0-1	4.17±4.17 0-12.5
E.globules crude	3.33±0.88 2-5	1.67±0.33 1-2	17.33±0.88 16-19	14.33±0.88 13-16	14.0±0.58 13-15	6.0±0.58 5-7	42.84±3.57 35.71-46.67	2.33±0.33 2-3	16.72±2.43 13.33±21.43	5.67±0.33 5-6	40.44±1.29 38.46-4286
talc powder	5.0±0.58 4-6	1.67±0.33 1-2	17.67±0.33 17-18	14.33±1.20 12-16	12.33±1.45 10-15	4.0±0.58 3-5	34.44±8.68 20-50	2.67±0.67 2-4	21.11±2.94 16.67±26.67	5.67±1.45 3-8	44.44±7.29 30.53.33
Control	18.67±0.88 17-20	11.0±1.16 9-13	14.0±0.58 13-15	6.67±0.33 6-7	87.0±6.66 75-98	Nil 0-0	Nil 0-0	7.0±1.0 5-8	7.97±0.71 6.67-2.09	80.0±5.77 70-90	92.03±0.71 90.90-93.33
L.S.D	1.72	1.72	2.033	-	11.77	2.11	-	-	-	9.74	13.89
F (Cal.)	76.34**	30.57**	67.12**	1.51	114.92**	14.80**	0.81	2.6	1.62	163.13**	71.62**
1st generation (F_1)											
E.globules Crude	3.0±0.58 2-4	1.33±0.33 1-2	18.0±7.02 10-32	Nil 0-0	0.33±0.33 0-1	0.33±0.333 0-1	33.33±33.33 0-100	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
talc powder	11.0±1.16 9-13	5.0±1.16 3-7	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
Control	19.33±1.20 17-21	12.33±1.76 9-15	14.0±0.58 13-15	7.33±0.33 7-8	83.66±6.36 73-95	Nil 0-0	Nil 0-0	5.0±1.0 3-6	5.89±0.93 4.11-7.23	78.66±5.55 70-89	94.11±0.93 92.77-95.89
L.S.D	3.52	4.26	-	-	17.68	-	-	-	-	-	-
F (Cal.)	64.32**	20.66**	0.32	-	171.23**	-	-	-	-	-	-

▪ From egg to pupation

Table (2): The delayed effect of prepared mixture of 5% (w/w) *C.aurantifolia* fine dust and Talc powder (w/w) on the fitness components of *phthorimaea operculella*

Treatments	Moth longevity (days)		Larval duration (days)▪	Pupal duration (days)	Number of resulted Pupae	Number of malformed Pupae		Number of dead pupae		Moth emergency	
	♀♀ $\bar{X} \pm S\bar{X}$	♂♂ $\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$
Parants generation (p)											
C.aurantifolia/ talc powder (5%)	10 ±0.58 9-11	8.0±0.58 7-9	31.67±0.88 30-33	13.0±0.58 12-14	12.33+1.20 10-14	3.0±0.58 2-4	25.02±5.37 14.29-30.77	2.0±0.58 1-3	15.61±3.30 10-21.43	7.33±0.88 6-9	59.38±3.03 53.85-64.29
C.aurantifolia crude	7.0±1.16 5-9	5.0±0.58 4-6	25.0±1.55 23-27	17.0±0.58 16-18	11.67±6.74 9-14	1.33±0.88 0-3	10.85±6.19 0-21.43	2.67±0.88 1-4	24.6±8.73 7.14-33.33	7.67±1.45 5-10	64.55±4.70 55.56-71.43
talc powder	5.0±0.58 4-6	1.67±0.33 1-2	17.67±0.33 17-18	14.33±1.20 12-16	12.33±1.45 10-15	4.0±0.58 3-5	34.44±8.68 20-50	2.67±0.67 2-4	21.11±2.94 16.67-26.67	5.67±1.45 3-8	44.44±7.29 30-53.33
Control	18.67±0.88 17-20	11.0±1.16 9-13	14.0±0.58 13-15	6.67±0.33 6-7	87.0±6.66 75-98	Nil 0-0	Nil 0-0	7.0±1.0 5-8	7.97±0.71 6.67-9.09	80.0±5.77 70-90	92.03±0.71 90.91-93.33
L.S.D	1.87	1.68	2.40	2.43	10.10	-	28.03	2.40	-	10.9	15.02
F (Cal)	55.25**	30.03**	147.17**	34.58**	117.52**	3.06	10.46**	9.17**	0.99	139.52**	18.62**
First generation (F_1)											
C.aurantifolia talc powder (5%)	6.33±0.67 5-7	3.67±0.67 3-5	18.0±7.02 0-32	Nil 0-0	0.33±0.33 0-1	0.33±0.33 0-1	33.33±33.33 0-100	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
*C.aurantifolia*Crude	7.0±1.16 5-9	4.33±0.67 3-5	26.67±0.88 25-28	Nil 0-0	3.67±0.88 2-5	1.0±0.58 0-2	21.67±11.67 0-40	2.67±0.33 2-3	78.33±11.67 60-100	Nil 0-0	Nil 0-0
talc powder	11.0±1.16 9-13	5.0±1.16 3-7	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
Control	19.33±1.20 17-21	12.33±1.76 9-15	14.0±0.58 13-15	7.33±0.33 7-8	83.66±6.36 73-95	Nil 0-0	Nil 0-0	5.0±1.0 3-6	5.89±0.93 4.11-7.23	78.66±5.55 70-89	94.11±0.93 92.77-95.89
L.S.D	3.48	3.77	-	-	12.85	-	-	-	32.49	-	-
F (Cal)	31.37**	12.22**	2.49	-	161.56**	1.0	0.11	4.90	38.32**	-	-

▪ From egg to pupation

Table (3): Effect of prepared mixture of *C.Sinensis* (5% & 10.%) fine dust and Talc powder (w/w) on the fitness components of parent generation (p) of *phthorimaea operculella*

Treatments	Moth longevity (days)		Larval duration (days)▪	Pupal duration (days)	Number of resulted Pupae	Number of malformed Pupae		Number of dead pupae		Moth emergency	
	♀♀ $\bar{X} \pm S\bar{X}$	♂♂ $\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$
Parants generation (p)											
C.Sinensis /Talc powder (5%)	15.0±1.16 13-17	10.33±0.33 10-11	26.67±0.88 25-28	10.0±0.58 9-11	10.33±0.88 9-12	0.33±0.33 0-1	2.78±2.78 0-8.33	1.67±0.66 1-3	17.22±8.07 8.33-33.33	8.33±1.20 6-10	79.99±6.94 66.66-90
C.Sinensis /Talc powder (10.%)	12.0±1.16 10-14	8.0±0.58 7-9	32.33±1.45 30-35	13.0±1.16 11-15	8.0±1.16 6-10	1.0±0.58 0-2	10.83±5.83 0-20	2.0±0-0 2-2	26.11±3.89 20-33.33	5.0±0.58 4-6	63.06±1.95 60-66.67
C.Sinensis crude	11.0±1.55 9-13	5.67±0.67 5-7	21.0±0.58 20-22	15.33±0.88 14-17	13.67±1.76 11.17	3.67±0.88 2-5	26.12±3.99 18.2±29.4	1.67±0.67 1-3	12..68±5.28 5.88±23.08	8.33±1.45 6-11	61.20±7.87 46.15±72.73
Talc powder	5.0±0.58 4-6	1.67±0.33 1-2	17.67±0.33 17-18	14.33±1.20 12-16	12.33±1.45 10-15	4.0±0.58 3-5	34.44±8.68 20-50	2.67±0.67 2-4	21.11±2.94 16.67±26.67	5.67±1.45 3-8	44.44±7.29 30-53.33
Control	18.67±0.88 17-12	11.0±1.16 9-13	14.0±0.58 13-15	6.67±0.33 6-7	87.0±6.66 75-98	Nil 0-0	Nil 0-0	7.0±1.0 5-8	7.97±0.71 6.67-9.09	80.0±5.77 70-90	92.03±0.71 90.91-93.33
L.S.D	2.76	1.81	2.69	2.82	10.13	2.03	18.80	2.15	-	8.84	18.24
F (Cal.)	24.75**	27.36**	72.20**	15.60**	111.99**	8.83**	6.20*	11.07**	2.13	136.40**	10.05**

▪ From egg to pupation

Table (4): The delayed effect of prepared lower mixture of *C.Sinensis* fine dust and Talc powder (w/w) on the fitness components of performed crosses of revealed moths of first generations (F_1) and second and (F_2)of *phthorimaea* operculella.

Treatments	Moth longevity (days)		Larval duration (days)▪	Pupal duration (days)	Number of resulted Pupae	Number of malformed Pupae		Number of dead pupae		Moth emergency	
	♀♀ $\bar{X} \pm S\bar{X}$	♂♂ $\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	$\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$	No $\bar{X} \pm S\bar{X}$	% $\bar{X} \pm S\bar{X}$
First generation (F_1)											
C.Sinensis / Talc powder (5%)	11.0±0.58 10-12	7.0±0.58 6-8	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
C.Sinensis / Talc powder (10.%)	7.33±0.67 6-8	4.0±0.58 3-5	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
C.Sinensis crude	3.67±0.33 3-4	1.33±0.33 1-2	24.0±0.58 23-25	15.67±1.45 13-18	7.66±1.20 6-10	2.33±0.33 2-3	30.63±1.41 28.57-33.33	1.33±0.33 1-2	19.21±7.17 10-33.33	4.0±1.6 2-6	50.16±8.45 33.33-60
Talc powder	11.0±1.16 9-13	5.0±1.16 3-7	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
Control	19.33±1.20 17-21	12.33±1.76 9-15	14.0±0.58 13-15	7.33±0.33 7-8	83.66±6.36 73-98	Nil 0-0	Nil 0-0	5.0±1.0 3-6	5.89±093 4.11-7.23	78.66±5.55 70-89	94.11±0.93 92.77-95.89
L.S.D	2.70	3.22	2.27	4.14	17.97			2.93	-	15.73	23.61
F (Cal.)	46.11**	16.25**	150**	31.25**	137.88**			12.09*	3.40	173.62**	26.72**
Second generation (F_2)											
C.Sinensis crude	2.33±0.33 2-3	1.33±0.33 1-2	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0	Nil 0-0
Control	16.33±0.88 15-18	10.67±1.45 8-13	14.33±0.88 13-16	6.67±0.33 6-7	81.33±6.06 71-92	Nil 0-0	Nil 0-0	3.0±0.0 3-3	3.73±0.28 3.26-4.23	78.33±6.06 68-89	96.27±0.28 95.7-96.74
L.S.D	2.62	-									
F (Cal.)	220**	39.19									

▪From egg to pupation