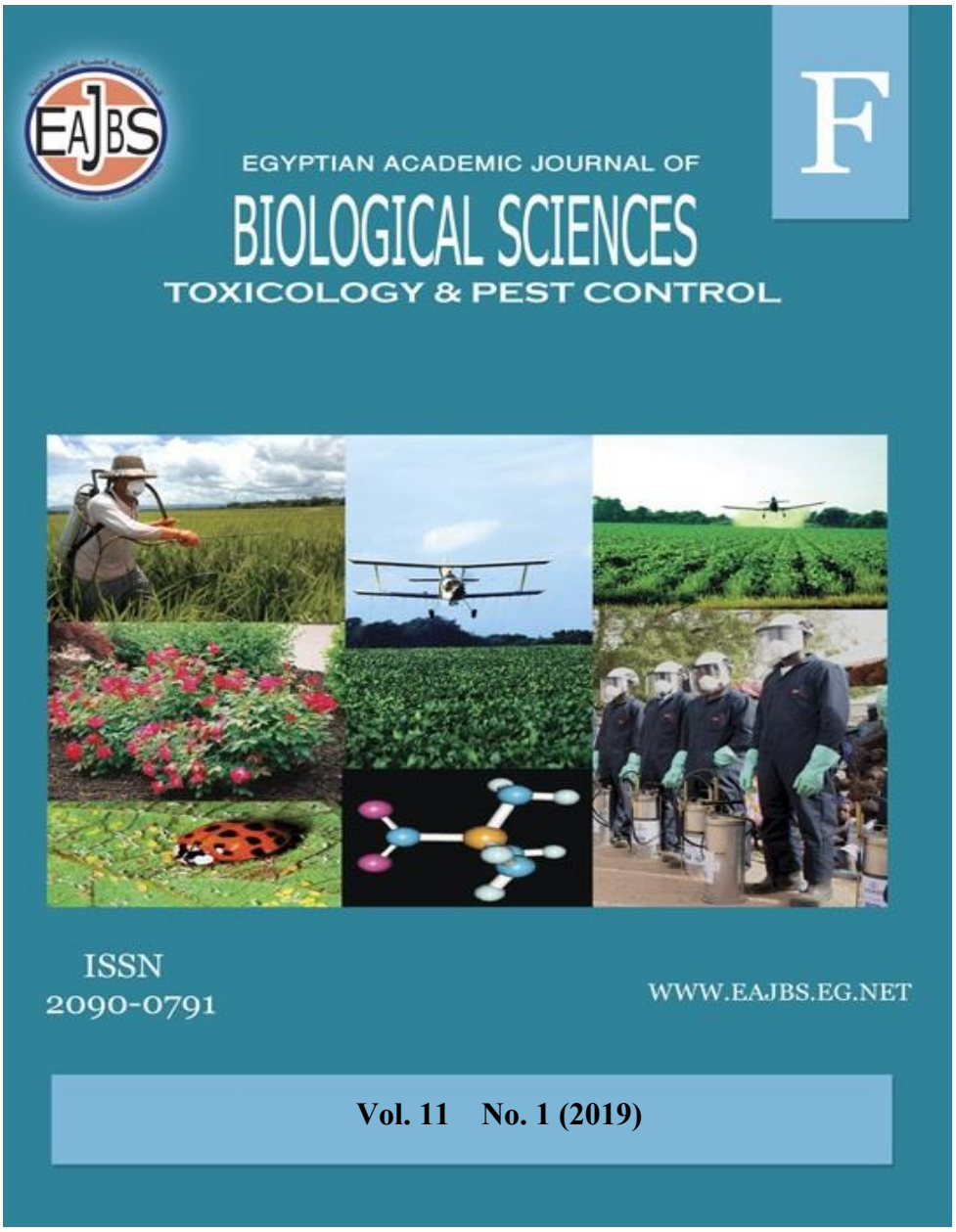

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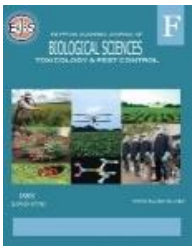

Non-chemical Approaches Suppressed Damage and Oviposition Rate *of Date Palm Hopper, Ommatissus lybicus*

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ABSTRACT

Chemical application is the most common practice widely used against date palm hopper (DPH), *Ommatissus lybicus* de Bergevin (Hem.: Tropiduchidae). Herein, we studied the efficiency of non-chemical approaches in suppressing DPH damage in the field condition. The study was carried out in a Randomized Complete Block design (RCB) with eight treatments, spraying micronized Kaolin (5% SP); Volck oil (1.5% EC); Citogate oil (1.5% EC); coconut oil soap (1.5% EC); yellow cards (six cards per 10 mature leaves and four cards per10 mature leaves); Diazinon (60% EC) and control, replicated three times. Results revealed that all treatments caused a sharp decrease in population of DPH (both adults and nymphs) up to the end of the third week and Diazinon was the most influential treatment ($F = 623.92$; $df = 7$; $P < 0.01$, $F = 367.71$; $df = 7$; $P < 0.01$, $F = 121.11$; $df = 7$; $P < 0.01$ for the first, second and third week after the experiment, respectively). This result was also confirmed by a decrease in the number of eggs laid by females DPH ($F= 53.89$; $d.f=7$; $P< 0.01$). All treatments significantly diminished the egg laying of DPH compared with control. The two of non-chemical treatments, Kaolin and coconut oil soap showed high efficiency in decreasing population of DPH without destructive effects on the environment, we can suggest these two eco-friendly products be used safely against Dubas bug. In addition, kaolin may contribute in decreasing the sunburn effects which is suggested to be studied by further research.

INTRODUCTION

Date palm hopper (Dubas bug), *Ommatissus lybicus* de Bergevin (Hem.: Tropiduchidae), is a key pest on date palm in Iran and other date palm growing countries (Asche and Wilson, 1989), causing economic damage on date palm and greatly losses its quality (Bagheri et al., 2016, 2017 and 2018). Currently, chemical application is the most common approach widely used for control of Dubas bug. However, excessive application of insecticides results in enormous negative environmental impacts, such as high pesticide residues on agricultural products, reduced biodiversity of biological control agents, the rapid development of resistance in pests, secondary pest outbreaks,

environmental pollution and ecological imbalances (Hong-xing et al., 2017). In addition to environmental concerns, synchronization of chemical application and the fruit harvesting season is another challenging issue threatening healthy of consumers and necessitates study on the non-chemical approaches to replace the chemicals.

Sticky color traps are easily operated and low-cost procedure frequently used in the integrated pest management (IPM) in pest forecasting as which to reduce the pest population to become the other managing components more efficient (Hashemi, 2006). The studies have been made on the efficacy of sticky color traps, revealed that the yellow cards with 560 nm wavelength could have the maximum mass trapping in date orchards and reduce the oviposition rate of DPH effectively (Damghani, 1992). The Kaolin is a mineral and water-suspendable compound containing Silicate Aluminium which provides a thin coverage on the plant foliage to reduce undesired sunlight and thermal stresses. The covering layer also provides a physical barrier against pests and diseases and causes the plants less preferred by pests for feeding and egg laying (Glenn et al., 1999). It has no toxicity for mammals and can be used in IPM successfully (Glenn and Puterka, 2005).

Oils are amongst the first chemicals used against various insect pests (Liu and Stansly, 2000). Fortunately, an increasing interest in application plant oils as a pesticide were seen nowadays which might be due to improvement has been made on their formulation, resulting in lower phytotoxicity compared with the earlier ones (Liu and Stansly, 2000). Although there are many chemicals with different mode of action, the oils still are greatly used in the pest control program due to several advantages over conventional insecticides, including safety to human and environment, apparent lack of resistance mechanisms among insects and mites, presumably due to action by suffocation, reliable efficacy and, relatively low cost (Liu and Stansly, 2000). In addition, oils as adjuvants mixed with other insecticides improve the efficacy of pesticides by decreasing evaporation especially in tropical and sub-tropical regions. They can also diminish washing off insecticides during rainy seasons (Liu and Stansly, 2000). Coconut oil is a fatty acid of lauric acid applied against soft body pests (Abbasi et al., 1984; Butler Jr et al., 1993).

Herein, we aimed to study the efficiency of eco-friendly approaches in controlling *O. lybicus* in the field condition and compare the results with Diazinon as a common insecticide widely used against this pest.

MATERIALS AND METHODS

This study was conducted on Zahedi as a susceptible date cultivar to *O. lybicus* in Farashband (Fars province). The study was arranged in a Randomized Complete Block Design with eight treatments, each replicated three times. Each experimental unit consisted of three date palms and totally 72 trees, identical in age and nutrition were included in the experiment. To minimize the overlapping effect of treatments, the sampling was done just on the middle tree in each experimental unit. To obtain an exact estimation of the efficacy of treatments, the sampling was made on 16 leaflets detached gently from four infested leaves in the second row of each tree. The leaflets were transferred to nylon bags and on return to the laboratory, the number of the immature and adults individuals were counted. The sampling was made one day before and 7, 14 and 21 days after the experiment.

The treatments were defined as spraying micronized Kaolin (5% SP); Volck oil (1.5% EC); Citogate oil (1.5% EC); coconut oil soap (1.5% EC); yellow cards (six cards per 10 mature leaves and four cards per10 mature leaves); Diazinon (60% EC) and

control. The yellow cards (10 × 25 cm) with 520 nm wavelength were hanged under the crown of the trees in four main geographical directions. These cards were refreshed at 3 or 4 days interval based on the infestation rate and weather condition. Before the experiment, all offshoots were removed. The effect of different treatments in reducing the adults and nymphs population was estimated using Henderson and Tilton formula. By the mortality caused in the adults, it is expected that the egg-laying rate in Dubas bug would be decreased, therefore, estimation of the eggs laid by adults in the different treatments can be a good measuring tool for comparing the treatments in another point of view. After hibernation or aestivation, these eggs will establish the next fundatrix females. The sampling procedure in this issue was the same mentioned above for the estimation of the mortality. Accordingly, the number of deposited eggs were counted on five leaflets employing a stereo-microscope.

Data analysis

The normality of data was checked by kurtosis and skewness tests in SPSS prior to analysis. Two-way analysis of variance (ANOVA) was used to test significant differences among treatments and then means were separated by the least significant difference (LSD) test. Statistical analysis was performed by SAS version 9.1.3.

RESULTS

Effect of Treatments on the Nymphs and Adults Mortality at the End of the First Week:

Analysis of variance revealed a significant difference among different treatments in the first week after the experiment ($F = 623.92$; $df = 7$; $P < 0.01$). The highest mortality was observed in Diazinon (98.44 ± 1.00), without significant difference with Kaolin. The yellow cards (6 cards for each tree) ranked in the second group. The other treatments were converged in the same group without significant differences with each other (Table 1).

Effect of Treatments on the Nymphs and Adults Mortality at the End of the Second Week:

In the second week, the same as the first, significant differences were seen among treatments ($F = 367.71$; $df = 7$; $P < 0.01$). Accordingly, Diazinon and Citogate had the highest (96.42 ± 2.84) and lowest (54.17 ± 11.03) impacts on the nymphs and adults of Dubas bug, respectively. No significant difference was observed among Diazinon, Kaolin and coconut soap. Also, Kaolin did not show significant difference with coconut soap and yellow card treatments (6 per each tree) (Table 1).

Effect of Treatments on the Nymphs and Adults Mortality at the End of the Third Week:

At the end of the third week, likewise the first and the second, the treatment were significantly different ($F = 121.11$; $df = 7$; $P < 0.01$). Diazinon was known as the most influential treatment again (98.24 ± 1.36) and yellow card treatments both had the lowest impact on Dubas bug nymphs and adults (53.06 ± 12.62 and 75.27 ± 16.94 for 4 and 6 yellow cards for each tree, respectively). Kaolin and coconut soap was ranked in the same category likewise the second week (Table 1).

Study of the egg deposition rate revealed significant differences among treatments ($F= 53.89$; $d.f=7$; $P< 0.01$). All treatments could significantly diminish the egg deposition rate of Dubas bug compared with control. As expected, the highest rate of eggs laid (67.78 eggs/leaflet) by adults in control. The lowest number of eggs were laid by adults in treatments, Diazinon and Kaolin (2.27 and 5.77 eggs/leaflet, respectively). The other treatments bunched in the same group without significant differences (Fig. 1).

Table 1- Mean (±SE) mortality rate of *Ommatissus lybicus* in different non-chemical and chemical treatments

Treatment	Mortality ±SE		
	First week	Second week	Third week
Yellow card 6	76.40 ± 1.37**b**	81.66 ± 3.58**bc**	75.27 ± 16.94**d**
Yellow card 4	68.08 ± 15.10**c**	73.99 ± 7.09**c**	53.06 ± 12.62**d**
Kaolin	92.92 ±2.99**ab**	94.66 ± 1.85**ab**	87.02 ± 7.32**ab**
Coconut oil soap	63.69 ± 22.06**c**	86.51 ± 4.02**abc**	85.59 ± 6.51**abc**
Citogate oil	66.66 ± 6.09**c**	54.17 ± 11.03**d**	94.93 ± 11.46**cd**
Volck oil	73.06 ± 11.02**c**	71.01 ± 10.37**c**	71.63 ± 10.83**bcd**
Diazinon	98.44 ± 1.00**a**	96.42 ± 2.84**a**	98.24 ± 1.36**a**

The means in each column with the same letter are not significantly different at 5% significant level

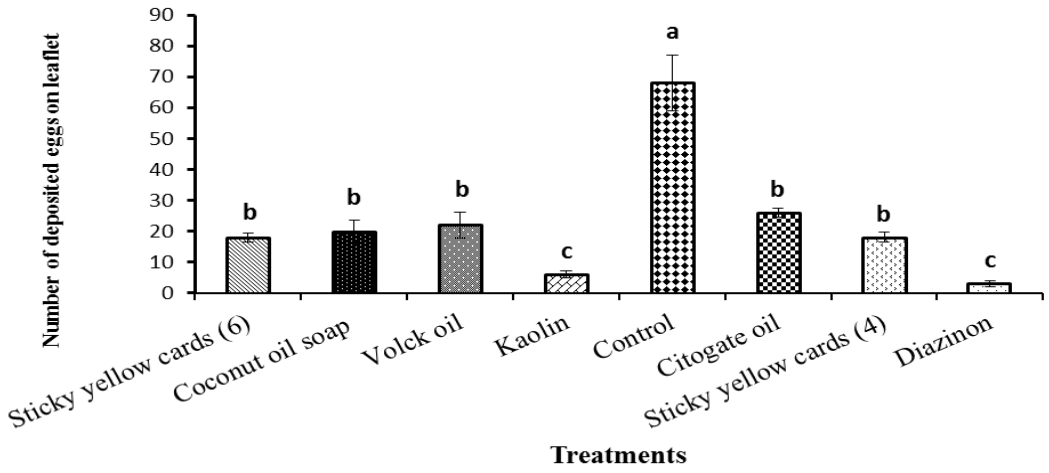

Fig. 1- The effect of different treatments on deposition rate of the dubas bug. Treatments with the same letter have no significant difference.

DISCUSSION

Dubas bug is one of the worldwide key pests of date palm causing highly economic damage and resulting in a decrease in quality and quantity of the product. Chemical control is the only available approach widely used against Dubas bug (Al-jboory et al., 2001; Howard et al., 2001). Herein, we compared the efficiency of different non-chemical approaches against Dubas bug and compared the results with Diazinon as one of the frequently used chemicals for control of this pest in Iran (Askari and Bagheri, 2005).

Results of the present study showed the possibility of replacing high risk and broad-spectrum insecticides by non-toxic or low-risk ones in control of economically serious pests like Dubas bug. The Kaolin and soap of coconut oil both belong to non-toxic compounds with a successful history in control of agricultural pests (Puterka, 1999; Falta and Psota, 2014; Sadeghi et al., 2014; Soubeih et al., 2017). Herein, we demonstrated the high and long-lasting effects of these compounds on Dubas bug either in decreasing the population or egg deposition rate which is a further emphasis on the high ability of these compounds. The yellow cards had also high impact on *O. lybicus* and ranked in the second position with a small difference with Diazinon, Kaolin and soap of coconut oil. This shows high capability of yellow cards in successfully suppressing Dubas bug, which is inconsistent with findings of Lashkari *et al.* (2008), who showed the same effect of

yellow cards and Decamethrine on *O. lybicus*.

Surprisingly, we found no significant difference among Diazinon, Kaolin and coconut oil which is a highly valuable finding and can shine a light on the use of non-synthetic compounds without concerns regarding their low efficiency. The Kaolin and coconut oil also reduced the rate of eggs laid in this pest and resulted in a sharp decrease in the next fundatrix population. The role of Kaolin as a mineral compound responsible for plants protection against insects, pathogen, sunburn and thermal stresses has been documented by different researchers (Glenn et al., 1999; Glenn and puterka, 2005; Wand et al., 2006). *Cacopsylla pyricola* (Förster) (Hemiptera: Psyllidae) (Pasqualini et al., 2002*), Agonoscena targionii* (Lichtenstein) (Hemiptera: Aphalaridae) (Saour, 2005) and *Homolodisca coagulate* (Say) (Hemiptera: Cicadellidae) vector of Pierce disease on grape trees has been evidenced (Puterka, 1999) are some insects pests on which the Kaolin has been exploited successfully.

We found high pest controlling activity of the coconut oil soap on *O. lybicus*. This compound consisted of various long chain fatty acids. Potassium salts of fatty acids are commonly called soap salts provides water solubility for the fatty acids. The lipophilic carbon chains of the fatty acids penetrate and disrupt the lipoprotein matrix of the insect's cellular membranes, resulting in the evacuation of cellular contents and causing the cell to dehydrate and die. Fatty acid toxicity is increased with increasing carbon chain length, typically peaking at C10, and then is decreased again. Fatty acid chain lengths of 18 carbons with one or two double bonds (unsaturated) also display insecticidal activity. There are good instances on the success effect of coconut oil on insect pests especially those with the soft body (Carr et al. 1991). However, coconut oil is a contact pesticide and should be in contact with pest's bodies (Butler Jr and Henneberry, 1990). This may explain its lower toxicity on *O. lybicus* (especially in adult stage) compared with Kaolin.

In all previous studies, the effect of controlling treatments on reducing the eggs laid by females was overlooked. Dubas bug has two distinct generation established by eggs laid by the last generations females after an aestivation/ hibernation (Hussain, 1963; Behdad, 1991). Therefore, the lowering egg laying potential of *O. lybicus* can be an important determining factor in the evaluation of pest controlling procedures

Conclusion

In conclusion, regarding the desired effects of Kaolin and coconut oil, as which because of no negative effects of these compounds on non-target organisms and environment, replacement of high-risk chemicals by Kaolin and coconut oil is strongly suggested. Since Kaolin may impact on date marketing, it can be suggested to be used on autumn (early-ripening date cultivars) or spring (late-ripening date cultivars) generation of Dubas bug based on the ripening season in the various date cultivars and the coconut oil or yellow cards be another alternative when the date is being ripened.

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REFERENCES

Abbasi, S.A., Nipaney, P.C. & Soni, R. (1984). Soap solution as an environmentally safe pesticide: For household insects-A preliminary investigation. *Comparative Physiology and Ecology*, 9(1), 46-48.

Al-Jboory, I.J., Al-Sammariae, A.I., Whaib, J.F. & Ahmed, W.A. (2001). Evaluation of thiamethoxam in different application techniques to control Dubas bugs

(*Ommatissus binotatus* lybicus DeBerg.). *Arab Journal of Plant Protection*, 19(20), 107-112.

Askari, M. & Bagheri, A. (2005) Study on the effect of imidacloprid on date palm hopper by soil application and injection. Proceedings: International Conference on Mango and Date palm: Culture and Export. 20th to 23rd June, *University of Agricult., Faisalabad, Pakistan*.

Asche, M. & Wilson, M.R. (1989). The palm-feeding planthopper genus Ommatissus (Homoptera: Fulgoroidea: Tropiduchidae). *Systematic Entomology*, 14(2), 127-147.

Bagheri, A., Fathipour, Y., Askari-Seyahooei, M. & Zeinolabedini, M. (2016). How different populations and host plant cultivars affect two-sex life table parameters of the date palm hopper, *Ommatissus lybicus* (Hemiptera: Tropiduchidae). Journal of Agricultural Science and Technology, 18(6): 1605-1619.

Bagheri, A., Fathipour, Y., Askari-Seyahooei, M. & Zeinalabedini, M. (2017). Reproductive isolation among allopatric populations of *Ommatissus lybicus* (Hemiptera: Tropiduchidae). Annals of the Entomological Society of America, 110(3): 337-343.

Bagheri, A., Fathipour, Y., Askari-Seyahooei, M. & Zeinalabedini, M. (2018). *Ommatissus lybicus* (Hemiptera: Tropiduchidae), an economically important pest of date palm (Arecaceae) with highly divergent populations. The Canadian Entomologist, 150(3): 378-392.

Behdad, E. (1991). Fruit pest of Iran. Neshat Esfahan Press. 822 pp.

Butler Jr, G.D. & Henneberry, T.J. (1990). Pest control on vegetables and cotton with household cooking oils and liquid detergents. *Southwestern Entomologist*, 15(2), 123-131.

Butler Jr, G.D., Henneberry, T.J., Stansly, P.A. & Schuster, D.J. (1993). Insecticidal effects of selected soaps, oils and detergents on the sweetpotato whitefly: (Homoptera: Aleyrodidae). *Florida Entomologist*, 76(1), 161-167.

Carr, A. (1991). Rodale's chemical-free yard & garden. Rodale Press.

Damghani, R. (1992). Study on biology of Dubas Bug in Bam, Kerman Province. Final report of a research project in Agricultural Organization of Kerman Province.

Falta, V. and Psota, V. (2014). Using coconut potassium soap “Cocana” in woolly apple aphid control. In Ecofruit. 16th International Conference on Organic-Fruit Growing: Proceedings, 17-19 February 2014, Hohenheim, Germany (pp. 199-201). Fördergemeinschaft Ökologischer Obstbau eV (FÖKO).

Glenn, D.M., Puterka, G.J., Vanderzwet, T., Byers, R.E. & Feldhake, C., (1999). Hydrophobic particle films: a new paradigm for suppression of arthropod pests and plant diseases. *Journal of Economic Entomology*, 92(4), 759-771.

Glenn, D.M. & Puterka, G.J. (2005). Particle films: A new technology for agriculture. Horticultural Reviews, 31, 1-44.

Hashemi, M. (2006). Study of the effect of different spectra and the height of yellow sticky card on the number of white fly attracted to this cards in cucurbit fields. M.Sc. thesis, Tehran University, Karaj. pp

Hong-xing, X.U., Ya-jun, Y., Yan-hui, L.U., Xu-song, Z., Jun-ce, T., Feng-xiang, L., Qiang, F.U. & Zhong-xian, L. (2017). Sustainable management of rice Insect pests by non-chemical-insecticide technologies in China. *Rice Science*, 24(2), 61-72.

Howard, F.W., Moore, D., Giblin-Davis, R.M. & Abad, R.G. (2001). Insects on palms (pp. 42–70). *Wallingford, Oxon, UK: CAB International.*

Hussain, A. (1963). Biology and control of the dubas bug, *omatissus lybicus* (Hom: Tropiduchidae) infesting date palm in Iraq. *Bulletin of Entomological Research*, 53(4), 737-745.

Lashkari, N., Mosadegh, M., Shishehbor, P. & Bagheri, A. (2008). Spatial distribution of Dubas bug in hajiabad, Hormozgan province and evaluation the efficacy of yellow sticky card in compare with pesticide application for its control. *Scientific Journal of Agriculture*, 3(1), 91-99. In Persian.

Liu, T.X. & Stansly, P.A. (2000). Insecticidal activity of surfactants and oils against silverleaf whitefly (*Bemisia argentifolii*) nymphs (Homoptera: Aleyrodidae) on collards and tomato. *Pest Management Science: formerly Pesticide Science*, 56(10), 861-866.

Pasqualini, E., Civolani, S. & Grappadelli, L.C. (2002). Particle Film Technology: approach for a biorational control of *Cacopsylla pyri* (Rhynchota Psyllidae) in Northern Italy. *Bulletin of Insectology*, 55(1-2), 39-42.

Puterka, G. (1999). Kaolin Clay for Management of Glassy-winged Sharpshooter in Grapes, Internet reference*:* http://www.attra.ncat.org. 4 pages.

Sadeghi, R., Jokar, M., Jamshidnia, A. & Ebadollahi, A. (2014). Repellency of Palizin®(Coconut Soap) with three laboratory techniques against five stored-product insect pests. Archives of Phytopathology and Plant Protection, 47(14): 1686-1695.

Saour, G. (2005). Efficacy of kaolin particle film and selected insecticides against pistachio psyllid *Agonoscena targionii* (Homoptera: Psyllidae) infestation. *Crop Protection*, 24(8), 711-717.

Soubeih, K.A., Ali, E.A. & El-Hadidy, A.E. (2017). Effect of kaolin and diatoms on growth, productivity and pests of potato under north sinai conditions. Egyptian Journal of Desert Research, 67(1), pp.83-114.

Wand, S.J., Theron, K.I., Ackerman, J. & Marais, S.J., 2006. Harvest and post-harvest apple fruit quality following applications of kaolin particle film in South African orchards. *Scientia Horticulturae*, 107(3), 271-276.