Egypt. Acad. J. Biolog. Sci., 5(3): 121 -127 (2012) A. Entomology
Email: egyptianacademic@yahoo.com ISSN: 1687–8809
Received: 15/ 5 /2012 www.eajbs.eg.net

Comparative efficacy of some insecticides against purple scale insect, *Lepidosaphes beckii* (Hemiptera: Coccoidea) and its parasitoid in citrus orchard in Egypt.

Dewer, Y.[1]; Abdel-Razak, S.[2] and Barakat, A.[2]
1- Central Agricultural Pesticide Laboratory, Plant Protection Research Station, Agricultural Research Center, Sabahia Station, Baccous Alexandria, Egypt.
2- Plant Protection Research Institute, Agricult. Res. Center, Alexandria, Egypt.

ABSTRACT

Five insecticide compounds Azadirachtin (Nimbecidine®); Pyriproxyfen (Admiral®); Acetamiprid (Mospilan®); Emamectin benzoate (Proclaim®) and summer mineral oil (star oil®) and their mixtures were evaluated for controlling the purple scale insect, *Lepidosaphes beckii* (Newman) (Hemiptera: Diaspididae) as well as its parasitoid *Aphytis lepidosaphes* Compere (Hymenoptera: Aphelinidae) on growing citrus orchard, *Citrus sinensis* L. (Rutacea). This work has been carried out in the experimental farm of faculty of agriculture, Sabahia, Alexandria, Egypt, during two successive seasons 2009 and 2010. The obtained results revealed that star oil® in combination with Admiral® and Nimbecidine® have given the highest reduction (%) values for *L. beckii* and its parasitoid, *A. lepidosaphes* during the two experimentally years. In 2009, the calculated reduction % values for *L. beckii* and *A. lepidosaphes* were (99.78 and 99.50%) and (96.75 and 97.29%), whereas in 2010 were (99.73 and 99.34%) and (94.40 and 96.46%) for the two combinations, respectively. On the other hand (Mospilan®) and (Proclaim®) show less reduction percentages to the parasitoid during the two successive years. Whereas in 2009 were 54.56 and 73.19 %, in 2010 were 43.47 and 71.25 %, respectively.

Keywords: insecticides, purple scale insect, parasitoid, Egypt.

INTRODUCTION

Egypt stands among the largest oranges producing countries in the world and occupies the third rank in production amongst the Mediterranean basin countries (FAO, 2011). Egyptian citrus has relation advantages in terms of yield and fruit quality, early ripening, relative low labor cost and nearness to international importing markets (Citrus Research Department, HRI, ARC, Egypt, 2012). Unfortunately, citrus trees are attacking by several insect pests among them the purple scale, *Lepidosaphes beckii* (Newman) (Hemiptera: Diaspididae).

L. beckii is a polyphagous species that has been recorded from hosts belonging to 45 genera in 11 plant families including citrus which attacks leaves, trunk and fruit (Davidson and Miller, 1990). It is a major destructive pest of citrus in Egypt and is widely distributed throughout the tropical and subtropical regions of the world (Danzig and Pellizzari, 1998). *L. beckii* is consider as a very common armored scale insects infesting orange orchards in Alexandria Governorate. Heavy infestation causes chlorosis of leaves, defoliation, discoloration and poor maturation of the fruit and desiccation, weakening and dieback of the branches or even entire trees (Cohic, 1955 and Gill, 1997).

Damage to fruits occurs in heavy infestations, where spotting and often deformity of fruits affects market value. Areas surrounding scales on fruit remain green long after the rest of the fruit ripens. The areas surrounding the scale insects on leaves turn yellow and when severely infested the entire leaf may be discolored prematurely and be shed (Aly, 2011).

Aphytis lepidosaphes Compere (Hymenoptera: Aphelinidae) one of the most important bio-agent for controlling the purple scale in different regions of the world (Dean, 1961; Abdel-Fattah and El-Saadany, 1978 and Hafez *et al.*, 1987 a and b). Hafez *et al*,1987b stated that the large number of *L. beckii* parasitized by the immature stages of *Aphytis* spp. were associated with the increase of living scales during January and February. The highest percentage of parasitism with the immature stages of *Aphytis* spp. was observed during the winter season, and the lowest percentage occurred during spring, summer and autumn. Extensive uses of chemical toxicants for pest control caused many problems, such as acute and chronic human and animal toxicity; development of insect resistance and environmental pollution (Malr, 1997).

Hence, the present work was initiated aiming to evaluate the efficacy of some insecticides and its mixture to control the most abundant scale insect *L. beckii* and its parasitoid *A. lepidosaphes* in citrus orchard in Alexandria, Egypt.

MATERIALS AND METHODS

Two field experiments 2009 and 2010 were carried out in the experimental farm of Faculty of Agriculture, Sabahia, Alexandria, Egypt to evaluate the efficacy of certain insecticides. The tested insecticide compounds were Mospilan®, Proclaim®, Nimbecidine® , Admiral® , Star oil ®, and their mixtures. The combination treatment, rate of application and sources of the used insecticides have shown in Table (1). The insect under study was the purple scale insect *L. beckii* as well as its parasitoid *A. lepidosaphes* on infested orange trees, *Citrus sinensis* L. (Rutacea). Ten treatments including the untreated (control) were replicated three times with three trees per replicate making a total of 90 orange trees, approximately having similar size, shape, height, and vigor.

Table 1: Type of treatments, rate of applications and the sources of it.

Compounds		**Rate/L water**	**Company**
Trade name	**Common name**		
Star oil	Mineral oil 95 % EC	15 Cm^3	International Company for Chemical Industries (GINTRA Egypt)
Nimbecidine	Azadirachtin 0.03% EC	5 Cm^3	T. Stanes and CompanyLimited
Admiral	Pyriproxyfen 10% EC	0.25Cm^3	Sumitomo Chemical Co. Ltd.
Mospilan	Acetamiprid 20% SP	0.25g	Nisso Co.
Proclaim	Emamectin benzoate 5% SG	0.20g	Syngenta Co.
Star oil+Admiral			Prepared mixtures
Star oil+Nimbecidine			
Star oil+Mospilan			
Star oil+Proclaim			
Untreated (control)	Untreated (control)		

Spraying was accomplished by means of a conventional knapsack sprayer with a 20 liters tank. With ensure to complete coverage of all parts of each tree. Thirty leaves from each treatment were collected immediately before spraying and after 2, 4, 6 and 8 weeks of application. The picked samples were put in marked cloth bags and

transferred to the laboratory for counting insects using the stereoscopic binocular microscope. To evaluate the efficiency of the tested compounds, the percentage of reduction was calculated according to the equation of (Stafford and Summers, 1963) for armored scale insect and (Henderson and Tilton,1955) for parasitoid. The data were analyzed through Randomized Complete Block Design. Analysis of variance and LSD value for comparing the mean of each treatment was adopted by (Snedecor, 1970).

RESULTS AND DISCUSSION

Our experiment was carried out during two successive years (2009 and 2010) at the end of the winter season before blooming and when the parasitoid individuals in a low level according to Hafez *et al.*1987b and Aly, 2011, in order to evaluate the effect of five insecticide compounds Azadirachtin (Nimbecidine®); Pyriproxyfen (Admiral®); Acetamiprid (Mospilan®); Emamectin benzoate (Proclaim®) and the summer mineral oil (star oil®) and their mixtures against *L. beckii* and its parasitoid *A. lepidosaphes.*

The obtained data shown in (Tables, 2 and 3 and Figs 1 and 2) revealed that the two compounds mixtures Star oil+Admiral and Star oil+Nimbecidine were the most effective treatments against *L. beckii* throughout the experiment period 2009 and 2010. Whereas the reduction percentage for Star oil+Admiral was (99.78 and 99.50%), the reduction percentage for Star oil+Nimbecidine was (99.73 and 99.34%) in 2009 and 2010, respectively (with no significant difference). At the same time, the reduction percentage was (96.08 and 96.62%); (92.25 and 90.19%) and (86.07 and 96.62%) for Nembecidine, star oil and Admiral alone in 2009 and 2010, respectively.

Table 2: Effect of tested treatments on the calculated reduction of *Lepidosaphes beckii* infested orange trees at Alexandria, Egypt. Spring 2009.

Sampling Time after treatments	Reduction (%) of tested treatment									
	Star oil	**Nimbecidine**	**Admiral**	**Mospilan**	**Proclaim**	**Star oil + Admiral**	**Star oil + Nimbecidine**	**Star oil + Mospilan**	**Star oil+ Proclaim**	**Untreated check**
2 weeks	82.57^{f}	89.20^{d}	46.80^{g}	82.35^{f}	86.24^{e}	99.27^{a}	98.70^{a}	94.35^{c}	96.56^{b}	30.38^{h}
4 weeks	93.71^{d}	95.63^{c}	97.56^{b}	73.78^{e}	95.19^{c}	99.86^{a}	99.89^{a}	99.49^{a}	99.51^{a}	47.34^{f}
6 weeks	95.90^{c}	99.84^{a}	99.91^{a}	90.35^{e}	92.92^{d}	99.97^{a}	99.94^{a}	97.76^{b}	96.34^{c}	41.69^{f}
8 weeks	95.92^{d}	99.62^{a}	100.00^{a}	98.10^{b}	91.43^{e}	100.00^{a}	99.44^{a}	96.54^{cd}	97.09^{bc}	10.95
Mean	92.25^{d}	96.08^{c}	86.07^{e}	86.15^{e}	91.45^{d}	99.78^{a}	99.50^{a}	97.04^{bc}	97.38^{b}	32.59

Table 3: Effect of tested treatments on the calculated reduction of *Lepidosaphes beckii* infested orange trees at Alexandria, Egypt. Spring 2010.

Sampling Time after treatments	Reduction (%) of tested treatment									
	Star oil	**Nimbecidine**	**Admiral**	**Mospilan**	**Proclaim**	**Star oil + Admiral**	**Star oil + Nimbecidine**	**Star oil + Mospilan**	**Star oil+ Proclaim**	**Untreated check**
2 weeks	78.85^{f}	90.48^{d}	63.13^{g}	81.92^{e}	78.97^{f}	99.28^{a}	98.44^{ab}	93.91^{c}	97.57^{b}	71.4
4 weeks	94.12^{c}	97.31^{b}	97.88^{b}	77.63^{d}	94.51^{c}	99.71^{a}	99.64^{a}	99.23^{a}	100.00^{a}	79.12
6 weeks	95.38^{c}	99.17^{a}	100.00^{a}	87.78^{e}	89.33^{d}	100.00^{a}	100.00^{a}	96.96^{b}	95.73^{c}	64.44
8 weeks	92.44^{c}	99.52^{a}	100.00^{a}	86.67^{d}	87.18^{d}	99.95^{a}	99.28^{a}	96.52^{b}	97.09^{b}	46.33
Mean	90.19^{c}	96.62^{b}	90.25^{c}	83.50^{e}	87.49^{d}	99.73^{a}	99.34^{a}	96.65^{b}	97.59^{b}	65.32

In addition, the two compounds mixture Star oil+Proclaim and Star oil+Mospilan gave (97.38 and 97.59%) and (97.04 and 96.65 %) reduction followed by Proclaim and Mospilan alone (91.45 and 87.49%) and (86.15 and 83.50%), respectively. Considering the probable occurring side effects of the tested compounds and there mixtures on the non-targeted parasitoid *A. lepidosaphes* (a main parasitoid of *L.beckii*) during 2009 and 2010, the data shown in (Table 4 and5 and Fig. 1 and 2) illustrate that Mospilan compound caused a lowest reduction effect (54.56 and 43.47%) followed ascending by Proclaim (73.19 and 71.25%), then the mixture Star oil+Proclaim (82.43 and 79.08%), Star oil (83.13 and 76.19%) and Nimbecidine (83.93 and 80.43%) with no significant differences between them. Then Admiral, Star oil+ Mospilan, Star oil+Admiral and Star oil+ Nimbecidine where they caused highest parasite reduction percentage reached (84.95 and 79.97%), (94.10 and 88.13%), (96.75 and 94.40%) and (97.29 and 96.46%) in respect without no significant differences between the two mixtures compound, Star oil+Admiral and Star oil+ Nimbecidine.

Table 4: Side effect of tested treatments on *Aphytis lepidosaphes* as a parasitoid of *Lepidosaphes beckii* infested orange trees in Alexandria, Egypt (spring 2009).

Sampling Time after treatments	Reduction (%) of tested treatment									
	Star oil	**Nimbecidine**	**Admiral**	**Mospilan**	**Proclaim**	**Star oil + Admiral**	**Star oil + Nimbecidine**	**Star oil + Mospilan**	**Star oil+ Proclaim**	**Untreated check**
2 weeks	57.58^{e}	49.77^{f}	50.09^{f}	14.23^{h}	73.04^{d}	88.08^{b}	92.01^{a}	84.06^{c}	38.05^{g}	37.13
4 weeks	87.34^{c}	88.01^{c}	90.13^{b}	84.67^{d}	88.09^{c}	99.41^{a}	98.93^{a}	98.58^{a}	98.74^{a}	32.98
6 weeks	94.90^{d}	98.45^{b}	99.80^{a}	37.39^{f}	45.52^{e}	99.75^{a}	99.55^{a}	96.43^{c}	97.25^{c}	46.47
8 weeks	92.70^{d}	99.49^{a}	99.80^{a}	81.96^{f}	86.12^{e}	99.76^{a}	98.67^{a}	97.35^{b}	95.71^{c}	46.06
Mean	83.13^{de}	83.93^{d}	84.95^{c}	54.56^{g}	73.19^{f}	96.75^{a}	97.29^{a}	94.10^{b}	82.43^{e}	40.66

Table 5: Side effect of tested treatments on *Aphytis lepidosaphes* as a parasitoid of *Lepidosaphes beckii* infested orange trees in Alexandria, Egypt (spring 2010).

Sampling Time after treatments	Reduction (%) of tested treatment									
	Star oil	**Nimbecidine**	**Admiral**	**Mospilan**	**Proclaim**	**Star oil + Admiral**	**Star oil + Nimbecidine**	**Star oil + Mospilan**	**Star oil+ Proclaim**	**Untreated check**
2 weeks	37.04a	32.17^{f}	37.94^{d}	17.06^{g}	36.49^{e}	82.06^{b}	92.87^{a}	75.66^{c}	32.30^{f}	51.65
4 weeks	85.96d	94.12^{c}	82.93^{e}	83.92^{e}	87.02^{d}	96.57^{ab}	95.36^{bc}	97.12^{a}	97.55^{a}	25.68
6 weeks	88.86d	97.67^{b}	99.48^{a}	72.92^{g}	80.33^{f}	99.46^{a}	98.77^{ab}	86.30^{e}	96.12^{c}	53.17
8 weeks	92.89c	97.77^{b}	99.50^{a}	73.59^{f}	81.18^{e}	99.48^{a}	98.83^{a}	93.44^{c}	90.34^{d}	51.06
Mean	76.19f	80.43^{d}	79.97^{d}	43.47^{h}	71.25^{g}	94.40^{b}	96.46^{a}	88.13^{c}	79.08^{e}	45.39

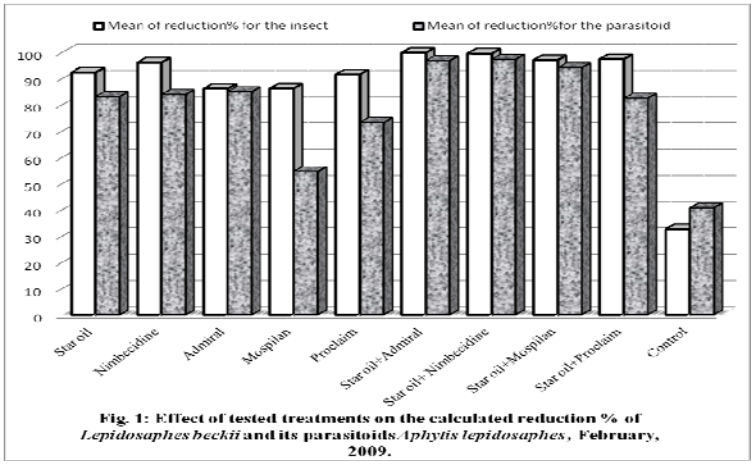

Fig. 1: Effect of tested treatments on the calculated reduction % of *Lepidosaphes beckii* and its parasitoids *Aphytis lepidosaphes*, February, 2009.

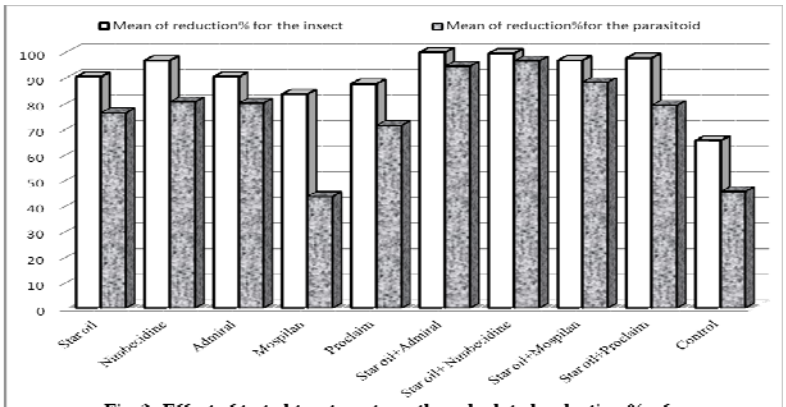

Fig. 2: Effect of tested treatments on the calculated reduction % of *Lepidosaphes beckii* and its parasitoids *Aphytis lepidosaphes*, February, 2010.

The obtained results agree with El-Deeb (2004) and Abo-Shanab (2005) whose stated that the use of insect growth regulators IGR_S and oils mixtures increase and facilitate efficient control of scale insect pest due to the significant inhibition of the enzymes activity. Unfortunately, the obtained results were not agree with them in the probability of using IGRs in the integrated pest management program (IPM) because it gives adverse side effect on the Parasitoid of the Purple scale insect, *L. beckii* on citrus orchard. Moreover, our data was in agree with Grafton-Cardwall *et al.* (2006) who stated that using of IGRs reduced the target pest, California red scale *Aonidiella aurantii* Maskell (Hemiptera: Diaspididae) as well as its parasitoid *Aphytis melinus* De Bach (Hemenoptera: Aphelinidae) on citrus orchard. Interestingly, Blank *et al.* (1995) and Abdel-Razak (2007) suggested that the use of mineral oil treatment at 1-1.5% is the preferred choice in integrated pest management program.

Finally, it could be concluded that the most effective treatments for controlling the purple scale insect , *L. beckii* during winter months where the parasitoid wasps population occur in a low level, is using the mixture of Star oil+Admiral and/or Star oil+Nimbecidine. On the other hand, when the parasitoid population is high during summer and spring months we recommended the spraying with Mospilan which gives low reduction percentages to the Aphelinide parasitoid with more effect on the target insect pest.

REFERENCES

Abdel-Fattah, M. I. and El-Saadany, G. (1978): The role of parasitoids in the control of the purple scale, *Lepidosaphes beckii* (New.) in Egypt. Zeitschrift für Angewandte Entomologie, 87 (1-4): 154-159.

Abdel-Razak, S.I. (2007): Studies on some scale insects and mealy bugs of deciduous fruit trees in western north coast and new localities. PhD Dissertation. Alexandria University. Egypt. 224 pp.

Abo-Shanab, A.S.H. (2005): Efficacy of some IGRs/ Insecticides. KZ oil and binary mixtures on mortality and enzyme activity of Egyptian mealybug *Icerya aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate. J. Pest Cont. and Environ. Sci., 13(1): 73-85.

Aly, N. (2011): Population dynamics of the purple scale, *Lepidosaphes beckii* (Hemiptera: Diaspididae) and its parasitoid Aphytis lepidosaphes (Hymenoptera: Aphelinidae) as a new threat pest on mango trees in Egypt. Egypt. Acad. J. biolog. Sci., 4 (1): 1-12.

Blank, R. H.; Gill, G.S.C. and Olson, M.H. (1995): Seasonal abundance of greedy scale (Hemiptera: Diaspididae) and associated parasitoids on taraire (*Beilschmiedia tarairi*). J. Econ. Entomol., 88: 1634-1640.

Cohic, F. (1955): Rapport d'une mission aux établissements français d'l'Océanie. Fascicle III. Enquête sur les parasites animaux des cultures. Institut Français d'Océanie, Nouméa, ORSTOM. 68 pp.

Citrus Research Department HRI, ARC, Egypt (2012): Horticulture Research Institute,Egyp.http://www.horticultureegypt.com/hri/index.php?option=com_contentandview = articleandid = 10%3 Acitrus - research-departmentandcatid = 2%3Afruit - departmentandItemid=23andlang=en.

Danzig, E.M. and Pellizzari, G. (1998): Catalogue of Palaearctic Coccoidea. Hungarian Academy of Sciences. Akaprint, Nyomdaipari Kft., Budapest, Hungary, 172-370.

Dean, H.A. (1961): *Aphytis lepidosaphes* (Hymenoptera: Chalcidoidea), an introduced parasite of purple Scale. Ann. Entomol. Soci. America, 54 (6): 918-920.

El-Deeb, M. F. (2004): Field toxicity and biochemical assessment of IGRs, Kz oil and their mixtures on the soft scale insect *Icerya seychellurum* (Westwood) (Homoptera: Margarodidae) attacking Guava trees. J. Adv. Agric. Res. (Fac. Agric. Saba Basha), 9 (2): 389-400.

Davidson, J. A. and Miller, D. R. (1990): Armored scale insects their biology, natural enemies and control 4B Elsevier/Netherlands, pp. 603-632.

FAO (2011): http://faostat.fao.org/site/339/default.aspx Food and Agricultural commodities production.

Gill, R. J. (1997): The scale insects of California. Part 3. The armored scales (Homoptera: Coccoidea: Coccidae). Technical Series in Agricultural Biosystematics and Plant Pathology No. 3. California Department of Food and Agriculture, Sacramento, California, USA., 307 pp.

Grafton-Cardwell, E. E.; Lee, J. E.; Stewart, J. E. and Olsen, K. D. (2006): Role of two insect growth regulators in integrated pest management of citrus scales. J. Econ. Entomol., 99 (3): 733-744.

Hafez, M. B.; El-Minshawy, A. M. and Donia, A. R. (1987a): Population fluctuations on parasites of *Lepidosaphes beckii* Newm. and *Ceroplastes floridensis* Comst. Anzeiger für Schädlingskunde, 60 (1): 6-9.

Hafez, M. B.; El-Minshawy, A. M. and Donia, A. R. (1987b): Parasitic efficiency of some hymenopterous *Aphytis* spp. on the purple scale insect *Lepidosaphes beckii* Newm. J. Appl. Entomol., 103 (1-5): 135 – 138.

Henderson, C. F. and Tilton, E. W. (1955): Tests with acaricides against the brown wheat mite. J. Econ. Entomol., 481, 157-161.

Malr (1997): "Agricultural pest control program" Annual book of Ministry of Agriculture and Land Reclamation, Egypt, pp. 5-40.

Snedecor, G. M. (1970): Statistical methods applied to experiments in Agriculture and biology. Iowa State Press, USA, 534 pp.

Stafford, E. M. and Summers, F. M. (1963): Evaluating control of San Jose scale. Univ. of California, print, Hilgardia., 35: 13-32.

ARABIC SUMMARY

مقارنة فعالية بعض المبيدات الحشرية ضد حشرة الموالح الأرجوانية، والطفيل المتخصص عليها في بساتين الموالح في مصر

يوسف دوير[1] وسعاد عبدالرزاق[2] و احمد بركات[2]
1- المعمل المركزي للمبيدات مركز البحوث الزراعيه - الصبحيه - الاسكندريه - جمهوريه مصر العربيه.
2- معهد بحوث وقايه النباتات- مركز البحوث الزراعيه - الصبحيه - الاسكندريه - جمهوريه مصر العربيه.

تم تقييم فاعليه خمس مركبات مبيدات حشريه (نمبسيدين - ادميرال- موسبيلان - بروكليم - و زيت معدنى صيفى ستار اويل و مخاليطهم) لمكافحه حشرة الموالح الارجوانيه و تاثيرهم على الطفيل المتخصص لهذة الافه على اشجار الموالح فى المزرعه التجريبيه لكليه الزراعه - الصبحيه - الاسكندريه. خلال موسمين متتاليين ٢٠٠٩ و ٢٠١٠.

النتائج المتحصل عليها اوضحت ان مخلوط الزيت المعدنى مع الادميرال و النمبسيدين اعطت اعلى نسبه خفض للافه المستهدفه و الطفيل خلال موسمى الدراسه ونسبه الخفض المحسوبه فى ٢٠٠٩ لكل من الافه و الطفيل كانت كالاتى (99.50% and 99.78) و(97.29% and 96.75) وحيث ان فى ٢٠١٠ كانت (99.34% and 99.73)و (96.46% and 94.40) على التوالى للمركبين .على الجانب الاخر المركبين موسبيلان و البروكليم اعطوا اقل نسبه خفض للطفيل خلال الموسمين موضع الدراسه حيث كانت خلال ٢٠٠٩ (73.19 % and 54.56) وفى ٢٠١٠ (71.25 % and 43.47)على التولى.