Evaluation of four chemical and natural compounds against whitefly, *Bemisia tabaci* (Genn.) in summer cultivation of cantaloupe plants, in Egypt

Tayeb, E. H. M., [1] H. A. Mesbah,[1] A. M. Kordy[1] and Randa M. Gouda[2]

1– Plant Protection Dep., Fac. Agric., Saba Basha, Alex. Univ., Egypt

2- Plant Protection Res. Institute, El- Sabaheia, Agric. Res Centre, Alex., Egypt

ABSTRACT

The present study was carried out during two successive seasons of 2005 and 2006 at the Agriculture Experimental Farm of El-Nobaria Research Station, El-Behaira Governorate. The adults and stages of whitefly immature attacking cantaloupe plants were surveyed, before and after insecticides application. Two chemical compounds (thiamethoxam [Actara®] and pymetrozine [Chess®]) and two plant natural products (azadirachtin [Achook®] - soybean oil [Natural oil®]) were also evaluated for the possibility of their involvement within an integrated control program for managing and controlling the whitefly on cantaloupe plants. The obtained results showed that after 30 days post-treatment of 1st application, the most effective rate of reduction against whitefly adults was achieved by thiamethoxam (Actara®) , followed by pymetrozine (Chess®) · soybean oil (Natural oil®) and azadirachtin (Achook®) during the two successive seasons of 2005 and 2006. In the first season, after 2nd application the highest general reduction of the insect-pest was achieved by the application of thiamethoxam (Actara®) followed by pymetrozine (Chess®) (soybean oil (Natural oil®) and azadirachtin (Achook®), while in the second season and after 2nd application the highest general reduction was achieved by thiamethoxam (Actara®) followed by soybean oil (Natural oil®) pymetrozine (Chess®) and azadirachtin (Achook®). During the first season, the high rate of reduction of the immatures was achieved by thiamethoxam (Actara®) 30 days post – 1st application followed by pymetrozine (Chess®), soyabean oil (Natural oil®) and azadirachtin (Achook®) which was the least efficient one among the tested compounds. During the second season the highest reduction percentage of the immature individuals of the whitefly was recorded for thiamethoxam (Actara®) throughout the period from 1st day up to 17 days post-treatment. The most efficient tested compounds against the immature of whitefly population achieved were (Chess®) and soybean oil (Natural oil®), followed by thiamethoxam (Actara®) and azadirachtin (Achook®) after the performance of 2nd application of these tested compounds where the reduction of whitefly immature was observed along the extended period from the 2nd till the 5th day post – application. Thiamethoxam (Actara®) showed a comparative significantly residual efficiency of 85.63% against the sprayed immatures of whitefly followed by azadirachtin (Achook®) (74.88%), soyabean oil (Natural oil®) (71.51%) and then pymetrozine (Chess®) (68.81%). Whereas, the residual values after 10 days post treatment of four used compound at 2nd spray, were for those treatments of thiamethoxam (Actara®) , soybean oil (Natural oil®) , pymetrozine (Chess®) and azadirachtin (Achook®), respectively. It was found that thiamethoxam (Actara®) was the most chemical effective compound compared with the

other tested compound. Also, soybean oil (Natural oil®) was more effective than the other tested natural compound azadirachtin (Achook®) and therefore, thiamethoxam (Actara®) and soybean oil (Natural oil®) can be involved in an IPM program for controlling whitefly attacking cantaloupe plants.

Keywords: whitefly, cantaloupe plants, natural insecticides, chemical insecticides

INTRODUCTION

Cantaloupe is one of the most important economic cucurbitaceaous vegetables cultivated in Egypt, both in the open field and greenhouses. It is considered to be one of the important summer vegetable crops for local market and exportation. Therefore, in recent time, the cultivated area with cantaloupe is increased especially in the new reclaimed areas. Cantaloupe plants are subjected to be infested by the sweet potato whitefly, *Bemisia tabaci* (Genn.) and in case of heavy infestation, this insect-pest cause serious damage to plants, and leading to great reduction in the final yield. The whitefly species complex has a world wide distribution and is recognized as a pest on over 500 plant species, including many important agricultural crops. The nymphal instars of *B. tabaci* as well as adults feed on phloem sap and excrete honeydew that hamper. Furthermore, whiteflies transmit over than 70 diseases (Duffus, 1987).

During the second half of the last century, pesticidal application were considered to be the only tool to suppress pests infestation, nevertheless the extensive and unwise use of chemical led to environmental pollution that caused many problems related to the ecosystem. So, the new strategy in pest control programs depends on integrated pest programs which using available methods to reach safe and reasonable pest control characterizing by effective and safe compounds which lead to a minimized rate of environment pollution. So, a new line of pesticides and bio-pesticides are being developed. These products can be

used to control many insect species and would be safe for farmers, domestic animals and the environment without causing any drastic side effects upon the beneficial insects (Stepnens, 1997).

The chemical insecticides such as thiamethoxan (Actara®) has been found to be effective for controlling aphids and thrips (Kang *et al.*, 2007). Also, pymetrozine (Chess®) is a highly active compound that can be used against susceptible and resistant aphids and whileflies in vegetables and other crops.

Moreover, neem has gained increasing attention as a "natural" insecticide and its activity has been evaluated against many economically important insect species (Schmutterer, 1990). Neem has deterrent, antiovipositional, antifeedant, growth disrupting (growth regulating), fecundity and fitness-reducing properties on insect (Mordue and Blackwell, 1993).The compound "Achook"® which is the principal insecticidal ingredient of neem seed extracts (extracted from the neem tree, *Azadirachta indica*) has been used for controlling the whitefly (Flint and Parks, 1990; Dimetry *et al.*, 1996; Khan *et al.*, 2003).

Soybean oil "Natural oil"® was used for controlling the piercing and sucking insect-pests and spider mite (Butler and Henneberny, 1991; El-Sebae *et al.*, 1997; Amer *et al.*, 2001; Paula and Bleicher, 2003).

Therefore, the present work has been conducted as an attempt to study and suggest some possible new approaches in the integrated pest program to control and prevent the probably occurring damage of the whitefly attacking cantaloupes under the prevailing conditions in open field protected cultivations. Two chemical and two natural insecticides were evaluated against the whitefly to select the more effective compounds that could be used in an integrated pest program for controlling the whitefly on cantaloupe plants, during summer cultivation in Egypt.

MATERIALS AND METHODS

Field experiments of summer seasons of 2005 and 2006

For performing the summer field experiments, an area of about 300 m^2 was chosen at Nobaria Experimental Farm, which has been divided into plots each of about 24 m^2 (6 x 4 m). Seeds were sown at a distance of 40-50 cm between hills in beds (1 m in width; 60 cm apart in between). The germinated plants were arranged in one row along the bed. Thereafter, the growing plants were kept under low tunnels. The experimental procedure and treatmental schedules were carried out according to the usual and recommended normal agriculture practices.

Field trials were conducted for studying the occurrence of the whitefly (adultus and immature stages) on growing cantaloupe plants, (*Cucumis melo* L., var. Ananas dokki).

Chemicals used

Thiamethoxam is a neonictinoid insecticide act as against of the nicotinic acetylcholine receptors was used as Actara® 25 % WG. Pymetrozine is a selective feeding blocker was used as Chess ® 25% WG. Azadirachtin is an ecdysone antagonist was used as Achook® 0.18% EC. Natural oil® (Soybean oils 93% L) and the other mentioned compounds were applied on cantaloupe plants. The rate of these insecticides application is shown in Table 1. All the tested compounds were supplied by the Ministry of Agriculture and Cairo chemical Company.

Field trails

Treatments were applied in a complete randomized block design with three replicates for each and the untreated control. In summer cultivation of cantaloupe, plants received two applications of each of the tested compounds which were performed at the recommended doses

against the whitefly. Application was made using knapsack sprayer (20 l capacity) Concentrations were prepared at the rate of the use of 200 liters water /feddan. Control plants were chosen amongst those ones faraway from the tested plants in different conducted treatments to avoid any contamination or interference of spray drift.

Sampling technique and pest's inspection

The occurring whitefly individuals on treated cantaloupe plants were inspected, counted and recorded throughout the adopted intervals of inspection. Inspections of treated plants were carried out before and after 1,3,5,7,10,17,24 and 30 days post-pesticides application. The occurring individuals of whiteflies adults were counted on ten randomizly chosen plants / replicate, whereas 30 leaves were picked at random from the canopy (lower, medium and upper parts) of each plant and they were put in plastic sacs, transferred to the laboratory, and examined under stereoscopic binocular microscope. The same treatmental inspection steps were followed during the performance of the second spray against the same pest, except a slight modification in sampling intervals was done , i.e.; 0,1,3,5,7, and 10 days for whitefly adult, 0,2,5,7 and 10 days for whitefly immatures.

Table 1: Pesticides and their rates of application during two cantaloupe growing seasons of 2005 and 2006

Compounds	Common name	Active ingredient (%)	Formulation.	Application Rate/fed.
Actara®	Thiamethoxam	25.00	WG*	80 g
Chess®	Pymetrozine	25.00	WG	80 g
Achook®	Azadirachtin	0.18	EC	750 ml
Natural oil®	Soybean oil	93.00	EC	625 ml

***WG** = Water dispersible Granules and **EC** = Emulsifiable Concentration

Calculation of infestation reduction

Post treatmental applications, the percentages of infestation reduction were calculated according to Handerson and Tilton (1955) equation as follows:

$$\text{Reduction \%} = \left[1 - \frac{a}{b} \times \frac{c}{d}\right] \times 100$$

Where:
a: population in treatment after spraying
b: population in treatment before spraying
c: population in check untreated (control) before spraying
d: population in check untreated (control) after spraying

Statistical analysis

Data were subjected to the analysis of variance ANOVA Test and the least significant differences (LSD) at the 5% level were determined according to computer program (COSTAT) and Duncan's Multiple Range Testes modified by Steel and Torrie (1981) to compare the average numbers of the inspected insect at different intervals.

RESULTS AND DISCUSSION

Effect of the tested chemical compounds against the inspected whitefly during the cultivation seasons of cantaloupe (2005&2006) under low tunnels

Whiteflies have become a major pest in vegetables as consequence of intensified crop production. A wide spectrum of insecticides frequently used to maintain high crop yield and quality exerted a strong selection pressure on whitefly population. Resistance was developed in whitefly against standard insecticides in many areas. Therefore, chemical control of whiteflies with broad spectrum insecticides did not acceptable nowadays and the selected ones were needed.

The exhibited results in Figures 1 and 2 elucidate the calculated percentages of whitefly numbers reduction (adult and/or immature) after the application of consequent 1st and 2nd sprays of the tested chemicals on cantaloupe plants during the summer seasons of 2005 and 2006.

Effect of tested chemicals on the adults

During the growing season of 2005, thiamethoxam (Actara®) proved to be the highly efficient tested chemical against adult whitefly population giving a high general mean of reduction 66.14% comprised after 30 days post-treatment. Soyabean oil (Natural oil®) and pymetrozine (Chess®) came next and showed merely equal rate of adults reduction amounted to 58.97% and 57.34% with no significant differences,respectively. Azadirachtin was proved to be the least efficient (32.82%) (Figure 1 - A).

Similar trend of results was also detected after the 2nd application of same tested compounds during the season of 2005. The superior effect of thiamethoxam (Actara®) was also proved and resembled by a calculated general mean of reduction of 81.69%, followed by pymetrozine (Chess®)

(74.63%), soyabean oil (Natural oil®) (72.47%) and the least efficient one azadirachtin (Achook®) (49.04%) (Figure 1-A).

Moreover, during the cultivation season of 2006, thiamethoxam (Actara®), pymetrozine (Chess®) and soybean oil (Natural oil®) proved to be efficient chemicals against the whitefly adults population and gave a merely similar rate of reduction comprised 68.15, 68.40 and 70.01%, respectively (Figure 1- B). That equal efficiency was proved by the statistical analysis of data which showed the non-significant differences between thiamethoxam (Actara®), pymetrazine (Chess®) and soybean oil (Natural oil®) versus the detected significant one found between each of them compared with the least efficient compound azadirachtin (Achook®) (45.17%) (Figure 1-B).

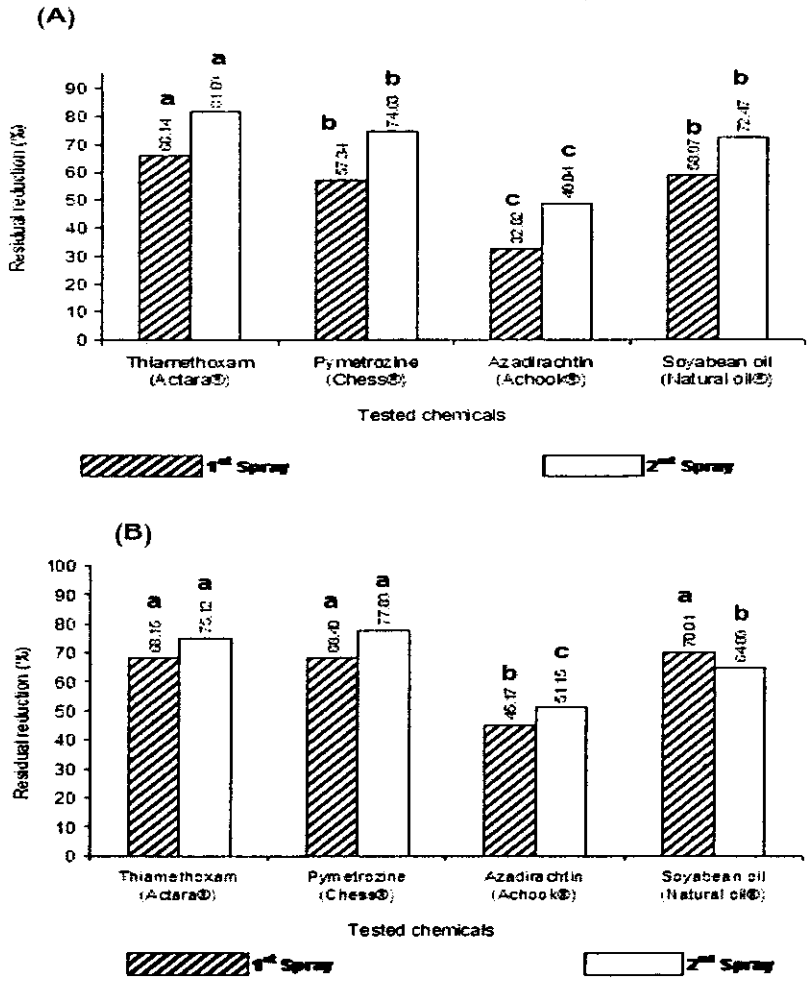

Fig. 1: Effect of the tested compounds on the general mean of reduction of the whitefly adults after 1st and 2nd spraying during the seasons of 2005 (A) and 2006 (B)

*** Means up the columns followed with the same letter are not significantly different concerning each spray at a time at 5% probability level.**

The effect on the whitefly immatures

Another trend of results was attained evaluating the treated compounds against immatures and is demonstrated in Figure 2. It illustrates the variable calculated reduction percentages of the inspected whitefly immatures on the treated cantaloupe plants due to the application of the tested compounds. Identically, each of the evaluated compounds was found to have more or less a toxic effect on the immatures of the whitefly.

In this concept, thiamethoxam (Actara®) also proved to be the highly effective tested compound against the immatures of whitefly population giving a high rate of reduction comprised 67.54% during the period of 30 days post-application; followed by pymetrozine (Chess®) (59.73%), soybean oil (Natural oil®) (53.91%) and the least effective azadirachtin (Achook®) (36.49%). (Figure 2-A).There were significant differences between all applied compounds.

A same trend of results was obtained after the 1st application was also revealed after the 2nd one of the tested chemicals. The superior effectiveness of thiamethoxam (Actara®) was also ascertained and resembled by a calculated general mean of reduction which amounted to 85.19%, followed by soybean oil (Natural oil®) (78.75%), pymetrozine (Chess®) 70.57% and the least efficient azadirachtin (Achook®) (52.15%)(Figure 2-A). The statistical analysis showed that there were no significant differences among the tested compounds.

Also, during the season of 2006, the first application cleared that both of pymetrozine (Chess®) and soybean oil (Natural oil®) were efficient compounds tested against the immatures of whitefly population and gave a merely high rate of reduction comprised 73.42 and 72.19%, respectively

was no significant differences followed by thiamethoxam (Actara®) (69.24%) and azadirachtin (Achook®) (53.14%) (Figure 2-B).

In addition to the above demonstrated results, thiamethoxam (Actara®) showed a comparative and significant residual efficiency of 85.63% reduction of immatures of the whitefly immature, followed by azadirachtin (Achook®) 74.88%, soyabean oil (Natural oil®) 71.51% and then pymetrozine (Chess®) (68.81%) (Figure 2-B) during the 2nd application.

Generally, it was found that thiamethoxam (Actara®) was the most chemical effective compound compared with the other tested compound. Also, soybean oil (Natural oil®) was more effective than the other tested natural compound azadirachtin (Achook®) and therefore, thiamethoxam (Actara®) and soybean oil (Natural oil®) can be involved in an IPM program for controlling whitefly attacking cantaloupe plants.

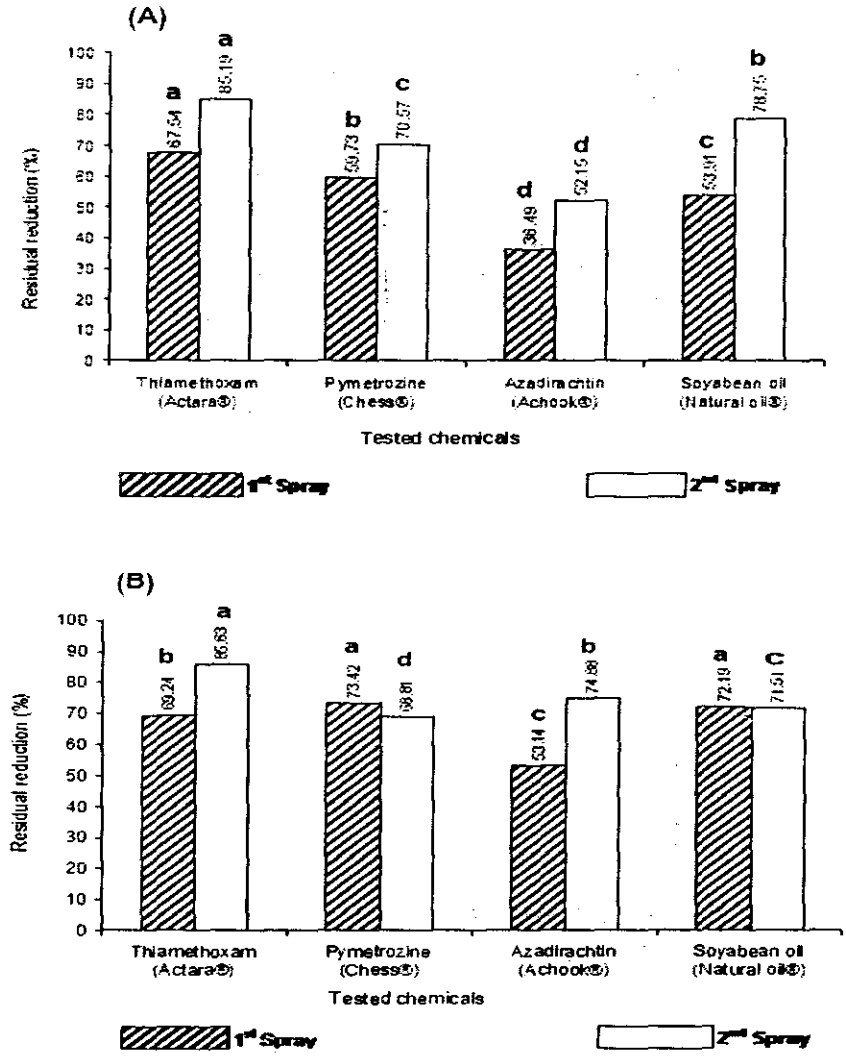

Fig. 2: Effect of the tested compounds on the general mean of reduction of the whitefly immatures after 1st and 2nd spraying during the seasons of 2005 (A) and 2006 (B)

*** Means up the columns followed with the same letter are not significantly different concerning each spray at a time at 5% probability level.**

The above demonstrated results are in agreement with those mentioned in the works of numerous investigators. Fluckiger *et al.* (1992) showed that pymetrozine, as a new antifeedant compound, was frequently effective against *Bemisia tabaci*, on French beans, *Phaseolus vulgaris*, that were resistant to other insecticides. Also, Polston and Sherwood (2003) reported that pymetrozine, a novel compound belonging to the class pyridine – azomethines, provided protection against transmission of tomato yellow leaf curl virus (TYLCV) by viruliferous whiteflies for up to 1 wk after a single application. The results indicate that pymetrozine could be an effective tool for tomato transplant producers to protect susceptible transplant from infection by begomoviruses, such as TYLCV. Pymetrozine might also work well as part of an integrated management in greenhouse tomato fruit production. Also, El-Maghraby (1997) stated that single use of Natural oil® at rate of 1250 ml and 625 ml/100 l of water is useful in IPM programs without mixing with insecticide to reduce the whitefly immatures population by 96.06 and 94.29% after treatment, respectively. In Egypt, Metwally *et al.* (1999) showed that both the mineral oil (Supermasrona®) and Natural oil® gave a highest percentage mortality of *B. tabaci* amounted to more than 90% for eggs and 80% for nymphs. Mason *et al.* (2000) showed that thiamethoxam (Actara® 25% WG) reduced the population of *B. tabaci* by killing activity and antifeedant and/or repellent action. Paula and Bleicher (2003) evaluated the efficacy of different types of oils and determined that castor bean and sesame seed oils were efficient in controlling whitefly nymphs, while soyabean oil showed low efficiency. Bao Yun *et al.* (2005) studied the toxic effect of thiamethoxam on *B. tabaci* (B-biotype) infesting cucumber seedling. They showed that the control of the pest using thiamethoxam was 290 times more effective than that of chlorpyrifos. Thiamethoxam reached a control level of 95.39% in 3 days

and that is identical in agreement with our obtained results in summer season 2006 after the 2nd application, whereas the calculated infestation reduction reached to 93% by thiamethoxam after 3 days.

REFERENCES

Amer, S. A. A. ; S. A. Saber and F. M. Momen (2001). A comparative study of the effect of some mineral and plant oils on the two spotted spider mite, *Tetranychus urticae* (Koch) (Acari: Tetranychidae). Acta Phytopathologica et Entomologica Hyngarica, 36 (1/2): 165-171.

Bao-Yun, X. U. ; L. Xiao and W. U. Qingjun (2005). Toxicity and controlling effect of thiamethoxam against *Bemisia tabaci*. China Vegetables, (3): 14-16.

Bulter, G. J and T. J. Henneberry (1991). Effect of oil sprays on sweet potato whitefly and phytotoxicity on watermelons, squash and cucumbers. Southwestern Entomologist, 16 (1): 63-72.

Dimetry, Nadia Z. ; A. A. Gomaa ; A. A. Salem and A. S. H. Abd-El-Moniem (1996). Bioactivity of some formulations of neem seed extracts against the whitefly *Bemisia tabaci* (Genn.). Anzeiger fur Schadlinskunde, 69(6): 140-141.

Duffus, J. E. (1987). Whitefly transmission of plant viruses. *In*: Current Topics in Vector Research, Vol. 4 (K.H. Harris, Ed.), PP. 73-91. Springer Verlag, New York.

El-Maghraby, H. M. (1997). Effect of single use of natural oil "Naturalis" alone or in combination with insecticides against the whitefly, *Bemisia tabaci* (Genn.) infesting tomato plants and its related virus. J. Agric. Sci., Mansoura Univ., 22 (10): 3315-3319.

El-Sebae, A. A. ; A. A.Y. El-Deeb ; N. I. Nousier and Farida A. Taman (1997). Antifeeding and ovicidal effects of six vegetable oils against the larvae and egg-masses of *Spodoptera littoralis* (Boisd.). Alex. Sci. Exch., 18 (4): 417-428.

Flint, H. M. and N. J. Parks (1990). Effect of Azadirachtin from neem (*Azadirachta indica*) tree on immature whitefly *Bemisia tabaci* (Homoptera: Aleyrodidae) and other selected pest species on cotton. J. Agric.Entomol., 6:211-215.

Fluckiger, C. R. ; R. Senn and H. Buholzer (1992). CGA 215'944 opportunities for use in vegetables. Proceedings Brighton Crop Protection Conference Pests and Diseases: 1187-1192.

Henderson, C. F. and E. W. Tilton (1955). Tests with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161.

Kang, T. ; Y. J. Jeon ; Y. C. Yang ; H. H. Kim and R. M. Cho (2007). Development of labor-saving pest management system for cut flower rose cultivation. Korean J. Hort. Sci. Technol., 25 (4): 418-424.

Khan, M. A. ; M. Afzaal and M. A. Nasir (2003). Evaluation of furnace oil and neem based products to manage *Bemisia tabaci* and leaf curl virus on cotton . Pak. J. Bat.,35 (5): 983-986.

Mason, G. ; M. Rancati and D. Basco (2000). The effect of thiamethoxam, a second generation neonicotinoid insecticide, in preventing transmission of tomato yellow leaf curl (Gemini virus) (TYLCV) by the whitefly, *Bemisia tabaci* (Gennadius). Crop Protection, 19 (7): 473-479.

Metwally, S. A. G. ; S. M. Ibrahim and A. M. Gabre (1999). Studies on the effect of certain substances on the population density of whitefly, *Bemisia tabaci* (Genn.) and cotton aphid, *Aphis gossypii* (Glover) attacking squash crop. J. Agric. Sci., Mansoura Univ., 24 (5): 2629-2634.

Mordue, A. J. and A. Blackwell (1993). Azadirachtin : an update. J. Insect Physiol., 39 (11): 903-942.

Paula, N. F. L. and E. Bleicher (2003). Evaluation of the effect of different types of vegetable oils on whitefly control on melon. Manejo Integrado de Plagas Agroecologia, (68): 53-56.

Polston, J. E. and T. Sherwood (2003). Pymetrozine interferes with transmission of tomato yellow leaf curl virus by the whitefly *Bemisia tabaci*. Phytoparasitica, 31(5): 490-498.

Schmutterer, H. (1990). Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. Ann. Rev. Entomol., 35: 271-297.

Steel, R. G. D. and J. H. Torrie (1981). Principles and procedures of statistic. A biometrical approach. 2nd Ed. McGraw. Hill Kogahusha Ltd. PP. 633.

Stepnens, D. (1997). Whitefly meets its match. Agric. Consultant, 36-53.

الملخص العربي

تقييم اربعة مركبات كيميائية وطبيعية ضد الذبابة البيضاء على الزراعات الصيفية للكنتالوب في مصر

رندا محمد جودة[2], أحمد محمد كردي[1] , حسن علي مصباح[1] ,السيد حسن تايب[1]

1- قسم وقاية النبات – كلية الزراعة (سابا باشا) جامعة الإسكندرية

2- معهد بحوث وقاية النبات – الصبحية - مركز البحوث الزراعية - الإسكندرية

أجريت هذه الدراسة بمحطة البحوث بالنوبارية بمحافظة البحيرة خلال موسمي 2006,2005 على نباتات الكنتالوب صنف أناناس دوقي حيث تم حصر للأطوار الكاملة وغير الكاملة للذبابة البيضاء التي تصيب هذه النباتات المنزرعة في الموسم الصيفي وذلك لتقييم كفاءة اثنين من المركبات الكيماوية (ثياميثوكسام- بيمتروزين) بالإضافة إلى مركبين طبيعيين من المستخلصات النباتية (الأزادارختين- وزيت فول الصويا) في التأثير على الحشرة الكاملة وحوريات الذبابة البيضاء وذلك لتقييم أدائهما وإمكانية إدراج تلك المركبات ضمن برنامج المكافحة المتكاملة للكنتالوب.

وقد أظهرت النتائج بعد 30 يوم من الرشة الأولى خلال موسمي الزراعة (2005-2006) أن أعلى نسبة خفض قد تحققت ضد الحشرات البالغة باستخدام مبيد ثياميثوكسام يليه كل من بيمتروزين ثم زيت فول الصويا ثم الأزادارختين.

كذلك وجد أيضاً أنه خلال الموسم الأول بعد الرشة الثانية أن أعلى نسبة خفض قد تحققت عند استخدام مبيد ثياميثوكسام يليه كل من بيمتروزين ثم زيت فول الصويا ثم الأزادارختين. أما في الموسم الثاني فقد كانت أعلى نسبة خفض قد تحققت باستخدام مبيد ثياميثوكسام يليه زيت فول الصويا ثم بيمتروزين والأزادارختين.

أما بالنسبة للأفراد غير الكاملة (الحوريات) فقد تحققت أعلي نسبة خفض خلال الموسم الأول بعد 30 يوم من المعاملة باستخدام مبيد ثياميثوكسام يليه البيمتروزين ثم زيت فول الصويا ثم الازادارختين. وخلال الموسم الثاني وجد أن أعلى نسبة خفض في الأفراد غير الكاملة قد تحققت بواسطة إستخدام مبيد ثياميثوكسام خلال فترة الفحص التي امتدت من 1 حتى 17 يوم بعد المعاملة.

وعلى المستوى العام من خلال نتائج موسمي الزراعة يتضح أن مركب الثياميثوكسام كان أكثر كفاءة من المركب الكيميائي الأخر وفي نفس الوقت تفوق على المركبات الأخرى المستخدمة، كما ويعتبر مركب زيت فول الصويا كمركب طبيعي ذو كفاءة بحيث يمكن إدراج الثياميثوكسام وزيت فول الصويا ضمن المركبات المستخدمة في برنامج مكافحة متكاملة لمكافحة الذبابة البيضاء في نباتات الكنتالوب.