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EFFECT OF SOME PEST CONTROL AGENTS ON WHITEFLY *Bemisia tabaci* (GENNADIUS) INFESTING TWO POTATO CULTIVARS

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ABSTRACT: **Efficacy of detergent soap (Sulphonic acid), two novel insecticides (Nomolt 15% SC and Mospilan 20% SP), one traditional insecticide (Evisect 50% SP), in addition to natural oil (Naterlo 97%) and three botanical insecticides [Zanzalacht fruit extract (*Melia azadirach*), Datura fruit extract (*Datura stramonium*) and Damsissa herb extract (*Ambrosia maritime* L.)] was estimated on sweet potato whitefly, *Bemisia tabaci* (nymphs & adults) and its associated parasitoids and predators on two potato cultivars, Spunta and Cara during two successive seasons 2007/08 and 2008/09 at El-Kenaiat district Sharkia governorate.**

Data revealed that sulphonic acid was the best control agent against the tested whitefly recording the highest percentage of adults killing during the most inspection dates, whereas it can be reduced the acidity of leaf surface, which providing antifeedent conditions for whitefly. Sulphonic acid caused % reduction in population of *B. tabaci* adults ranged between 80.74-65.01%, while natural oil induced the highest % reduction in population of whitefly nymphs ranged between 78.6 - 63.59%.

Datura fruit extract and Mospilan exhibited acceptable initial and good residual effects against the two stages of whitefly during both seasons, while Nomolt, Evisect and Zanzalacht fruit extract recorded relatively moderate influence ranged between 62.35 to 44.69% reduction against the two stages of insect.

On the other hand, the effect of treatments on natural enemies harboured the two potato cultivars were differed from one

compound to another where Zanzalacht fruit extract was the most safe.

In respect to the yield, there were significant differences between the experimental treatments which recorded the highest yield 158kg/plot and 156 kg/plot for Spunta treated with Sulphonic acid at 1st and 2nd seasons, respectively. While, Spunta variety treated with Damsissa recorded the lowest yield at 2nd season (134.5 kg/plot).

Key words: Control, *Bemisia tabaci*, plant extract, sulphonic acid, natural oil, neonicotinoid, potato.

INTRODUCTION

Potato, *Solanum tuberosum* L., is a crop of an outstanding importance in Egypt on account of its great value for local consumption and export. It occupies second rank after onion in regard to vegetables exportation. Potato could be an important crop to solve the international food problem. It can be cultivated in 2-3 seasons in the same year, and also be cultivated in various soil and weather conditions. It is also rich in the main nutritive components of the human diet. In Sharkia Governorate, the total area of potato cultivation reached 7167feddan according to the statistics of Economic Sector of Agricultural and Land Reclamation Ministry (2008/09).

In Egypt, numbers of factors threaten potato cultivation such as sweet potato whitefly, *Bemesia tabaci* (Gennadius) which is considered the most common serious pest of potato plants (Ibraheem *et al.*, 2005). Farmers throughout the world have traditionally been encouraged by commercial, government and consumer interests to use synthetic chemical pesticides for a "fast effective fix" to pest problems. After the use and abuse of chemical pesticides, all of these interests, as well as the farmer, now understand that chemical insecticides have a limited life and that excessive and repeated use create many problems as pest resistance, pest resurgence and environmental polution. Effective pest management requires a diversity of tools and the flexibility that those tools will bing (Inceoglu *et al.*, 2001). Chemical pesticides are still the main approach for pest control, but their use is becoming more controversial. The concept of biocides is being eco-friendly as

well as environmentally safe and specificity to most of the target pests (Girigs, 2003). Because of the great current concern about the environment indicates a need to limit application of chemicals for lant pests control. The physical properties of leaf surfaces are great importance in regulating the severity of attack by sucking insects. Labial exploration of the surface takes place before insertion of the stylet into the tissue (Sogawa, 1982).

Therefore, the effect of Sulphonic acid is due to its ability in decreasing surface tension of water, also to its high acidity that cause impairment of cuticle layer of the pest and making the target media unsuitable for pest surviving (Abou-Lila *et al.*, 1999 and Mousa and El-Sisi, 2001). Therefore, it is necessary to develop insecticides with alternative modes of action (i.e., plant extracts) that do not persist in the environment and are potentially compatible with natural enemies. Many natural substances can be used as pesticides such as extracts of pyrethrum, garlic, tea tree oil and eucalyptus oil. When these natural chemicals are used as pesticides they become subject to the same controls as pesticides produced synthetically.

The objective of this study is to evaluate the efficacy of certain bio and recommended insecticides against sweet potato whitefly *Bemicia tabaci* on potato.

MATERIALS AND METHODS

Experiments were conducted at El-Kenaiat district, Sharkia Governorate during 2007/08 and 2008/09 seasons to evaluate some control agents on the sweet potato whitefly, *Bemisia tabaci* (Genn.) (adults and nymphs) attacking two potato cultivars (Spunta and Cara) during winter plantations. The experimental areas were divided into 27 equal plots each of $42m^2$ as replicates for each variety including untreated plots, each replicated 3 times and distributed in a complete randomized block design. Spunta and Cara varieties were cultivated in October 15 and 21 in seasons 2007 and 2008, respectively. Normal recommended agricultural practices were applied. Two sprays were carried out after 30 days from planting when population became the highest. The numbers in last inspection of first spray (at fifteen day) was considered as the pre-count population of the second spray. A knapsack sprayer equipped with

one nozzle was used in applying the chemical compounds as foliar treatment, diluted with water at the rate of 300 liter/feddan.

The tested compounds used/100 liter water were:

1. Detergent soap (Sulphonic acid 1 %) (1000 ml). (Anti-oxidant compound) It is produced by El-Ameria Co. for petroleum refining, Alex.
2. Teflubenzuron (Nomolt 15 % SC benzoylurea) (50 ml). It was produced by SHOURA chemicals.
3. Acetamiprid (Mospilan 20% SP neonicotinoid) (25 gm). It was produced by SHOURA chemicals.
4. Thiocyclam (Evisect 50% SP natural pesticide) (125 gm) related to neurotoxin, a naturally occurring extract from marine annelids (*Lumbrinoris* sp).
5. Natural oil (Naterlo 97%) (625 ml). It is a blend of vegetable oil; emulsifiers and antioxidant. It contains 93% pure vegetable oil. It was provided by STOLLER chemical Company, U.S.A.
6. Zanzalacht (*Melia azedarach*) (500 ml).

Zanzalacht Extract Preparation

Fruit of *Melia azedarch* obtained from ornamental gardens of Faculty of Agriculture, Zagazig Univ. were left 2-weeks at room temperature for drying and grounded into fine powder in an electric mill. Two hundred grams of the ground fruits were soaked for 24 hours in water at rate of 1 kg/10 liter water then filtered for using it at a rate of 5 ml/L (Abo-El-Ghar and El-Sheikh, 1987).

7. Datura (*Datura stramonium*) (500 ml) Datura extract preparation.

Datura Fruit Extract Preparation

The same tequnic in the Zanzalacht extract preparation was followed.

8. Damsissa (*Ambrosia maritime*) (500 ml).

Damsissa Extract Preparation

A 50 gm of dried whole herbs was added to 60% ethyl alcohol, set up for 2-3 days at room temperature, then filtered. The dried whole herb retreated again using 60% ethyl alcohol, then filtered and evaporated using a rotary evaporate. The solvent dimethyl sulfoxide added to the dried material in 0.25% to obtained the aqueous extract of *Ambrosia*

maritime L. for using it at a rate of 5 ml/L (Mahmoud *et al.* 2005).

To estimate the percentage of infestation with the whitefly *B. tabaci* adult and nymphs, Ministry of Agriculture protocol was followed, samples of 10 leave/replicate were selected at random. A mirror was used to observe the underside of leaf without disturbing the adult of insects (Butler *et al.*, 1986). Sampling was done before spray directly and after 2, 5, 7, 10 and 15 days of application. The adults of whitefly and any natural enemies' numbers were counted visually in the field directly before cutting the leaf samples to determine the nymph numbers. The population density of the larvae (nymphs) was carried out by transferring the plant leaf in paper bags to the laboratory for inspection by the aid of stereomicroscope.

The mean reduction percentages of *B. tabaci* population in treatments were estimated following Henderson and Tilton formula (1955):

$$\text{Reduction \%} = (1-(A/B \times C/D)) \times 100$$

Where:

A=Number of insects in treatments after application.

B=Number of insects in treatments before application.

C = Number of insects in check before application.

D = Number of insects in check after application.

Appropriate analysis of variance on results of each experiment was performed (Costate Software, 1985). Comparisons among the mean of different treatments were undertaken using the revised L.S.D. procedure at p= 0.05 level as illustrated by Smith (1978).

RESULTS AND DISCUSSION

Efficacy of the Tested Compounds on Whitefly Infesting Potato Cultivar, Spunta Variety

Data in Table 1 shows the effect of the tested materials on the population of *B. tabaci* adults (A) and nymphs (N) infesting potato cultivar variety Spunta at 2007/08 season. The results clearly indicated that all the tested materials except Damsissa plant extract reduced significantly the

Table 1. Mean numbers and reduction percentages (% R) of adults (A) and nymphs (N) of whitefly, *B. tabaci* Genn. inhabiting potato Spunta variety as influenced by the tested agents (2007/08 season)

Agents	Rate/ 100 liter water	First spray								Second spray								General effect	
		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect **		Total effect ***		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect **		Total effect ***			
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
Sulphonic acid	1000 ml	14.7	2.5	4.0 76.33a	1.0 62.8e	6.9 74.8b	1.33 76.7ga	6.32 75.11ab	1.26 73.99b	15.5	15.17	6.8 61.83b	5 75.16	6.48 76.71	2.73 90.58a	6.54 73.74b	3.18 87.5a	6.43 74.42b	2.22 80.74a
Nomolt	50 ml	12.6	2.8	8.2 43.38ef	2.0 33.57f	8.0 61.94d	2.43 66.53c	8.04 58.23d	2.34 59.93de	17.8	16.0	16.2 24.82de	11.2 45.4c	12.4 59.18d	8.9 69.61c	13.16 51.51d	9.36 64.77d	10.6 54.87d	5.85 62.35d
Mospilan	25 gm	14.3	3.1	9.0 45.25e	1.1 76.6	5.18 79.26a	1.5 80.4a	5.94 72.46b	1.4 77.72a	20.0	10.9	8.0 65.2a	3.4 75.16a	4.98 78.95b	5.8 72.3c	5.58 76.2b	5.32 72.96c	5.76 74.33b	3.36 75.34b
Evisect	125 gm	15.2	3.1	9.8 43.91ef	1.8 46.0d	8.45 69.29c	3.2 5937d	8.72 64.21c	2.92 56.69e	22.0	14.8	16.0 36.73c	12.11 36.23d	9.75 68.93c	12.85 63.41d	10.22 62.49c	13.48 57.97e	9.47 63.35c	8.2 57.33e
Natural oil (Naterlo)	625 ml	13.8	6.9	5.4 65.96b	2.1 71.7a	3.78 79.61a	4.8 80.62a	4.1 76.88a	3.23 78.84a	20.5	15.3	9.0 61.8b	9.8 50.0 b	5.23 84.95a	4.15 83.63b	5.98 80.32a	5.28 76.9b	5.04 78.6a	4.25 77.87b
Zanzalacht	500 ml	13.4	5.2	6.7 56.5c	2.2 60.65e	9.53 61.49d	5.08 61.6d	8.96 60.49cd	4.5 61.12cd	21.4	17.6	20.2 18.69e	13.8 36.68d	11.88 55.78d	16.2 62.62d	12.26 48.36d	17.0 57.43e	10.61 54.43d	10.75 59.28e
Datura	500 ml	19.5	2.0	11 50.92d	1.3 39.55e	7.5 78.35a	1.45 70.71b	8.2 72.86b	1.42 64.48c	17.5	9.2	7.2 64.2ab	8.1 31.3e	4.03 85.73a	2.95 80.88b	4.66 81.42a	3.98 77.6b	6.43 77.14ab	6.09 71.04c
Damsissa	500 ml	14.9	4.6	10 41.61f	4.0 19.13g	13.23 54.74e	6.3 46.0e	12.58 52.11e	5.96 40.63f	18.2	13.8	16.4 21.6d	12.8 27.65f	11.3 55.59d	10.63 59.12d	12.32 48.87d	11.06 52.83c	12.45 50.49e	8.51 46.73f
Control	Water	20.8	7.4	23.9	8	21.95	18.7	22.34	16.56	22.2	17.2	25.4	22.2	38.8	33.0	36.12	30.84	29.23	23.7
$L.S.D_{0.05}$				2.29	2.74	3.30	3.67	3.82	3.41			2.52	2.67	3.52	4.37	3.24	3.14	3.35	2.74

** Residual effect = Mean number at (5+8+11+15 days)/4 *** = Total effect = [(mean of residual ×4) + initial effect]/5
General effect = (*** of 1st spray + *** of 2nd spray)/2

population. It can be arranged in a descending order for both nymphs and adult stages as follows: (Natural oil, Sulphonic acid), (Datura, Natural oil), (Sulphonic acid, Mospilan), (Mospilan, Datura), (Evisect, Nomolt), (Nomolt, Zanzalacht), (Zanzalacht, Evisect) and (Damsissa, Damsissa). The corresponding percent reduction for these materials were (78.6%, 80.74%), (77.14%, 77.87%), (74.42%, 75.34%), (74.33%, 71.04%), (63.35%, 62.35%), (54.87%, 59.28%), (54.43%, 57.33%) and (50.49%, 46.73%), respectively. It can be proved that Natural oil gives the highest mortality percentage for nymph after two sprays reached 78.84% and 78.60%, respectively. Natural oil may surround this the pest nymphs with a film which may prevent the insect from feeding and breathing and thus from being alive. Datura and Sulphonic acid showed the second high percentages of nymphal decrease in the population (77.14% and 74.42%), respectively. In this respect, EL-Lakwah and Mohamed (1999) obtained good results by using Datura fruit extract which gives high mortality values (60-70%) at a higher concentration (5and 10%) after 7 days from treated cowpea beetle *Callosobruchus maculatus*. On the other hand, Sulphonic acid give a high percentage of nymphal and adults killing during the most inspection dates. These findings are agree with those obtained by Abou-Lila *et al.* (1999) and Sogawa (1992). Also, EL-Sisi *et al.* (2009) found that Sulphonic acid showed highly acidty without any characters in leave of treated plants up to 30 days after spraying and give % reduction in the black parlatoria scale insect, *Parlatoria ziziphus* ranged between 65.89% to 86.67% after one month of treatment. Jian-Wang *et al.* (1992) demonstrate that charge density is depends on the quantity of functional group per unit surface of cell wall mass and is affected by carboxy esterification and external medium PH. Also, Muzammil-Sattar *et al.* (2005) showed that low densities of whitefly (15.04±1.25 per leaf of water melon) were associated with low PH (6.55± 0.008).

Data in Table 2 show the effect of the tested treatments on the population of *B. tabaci* (N and A) infesting potato cultivar variety Spunta at 2008/09 season. Data show that all the tested materials except Damsissa extract that decreased significantly the pest population of the studied insect pest.

Sulphanic acid caused the highest effect for both nymphs and

Table 2. Mean numbers and reduction percentages (% R) of adults (A) and nymphs (N) of whitefly, *B. tabaci* Genn. inhabiting potato Spunta variety as influenced by the tested agents (2008/09 season)

Agents	Rate/ 100 liter water	First spray								Second spray								General effect	
		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect**		Total effect ***		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect**		Total effect***			
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
Sulphonic acid	1000 ml	18.7	5.5	6.7	2.5	8.2	3.63	7.9	3.4	10.4	6.2	4.2	2.6	3.28	2.58	3.46	2.58	5.68	2.95
				68.47a	98.0a	77.81ab	71.89c	75.94a	77.11b			63.65a	66.45a	78.53a	76.2a	75.56a	74.25a	75.75a	75.68a
Nomolt	50 ml	19.2	5.2	14.0	3.8	15.7	4.35	15.36	4.24	14.5	5.2	8.8	4.4	7.45	3.5	7.72	3.68	11.54	3.96
				35.38e	34.23e	53.46e	62.88e	49.94f	57.15d			38.0d	32.31e	63.54b	59.61f	58.43c	54.15a	54.19e	55.65d
Mospilan	25 gm	14.3	3.1	9.0	1.1	3.68	1.5	4.74	1.42	8.2	4.8	3.8	2.0	3.85	2.53	3.84	2.42	4.29	1.92
				44.62e	68.67a	79.39e	77.16b	72.44b	75.34b			58.29b	66.67a	78.53a	70.21c	74.48a	69.5c	73.46bc	72.72b
Evisect	125 gm	14.6	4.0	12.29	3.2	10.8	4.25	11.08	3.96	16.8	4.8	14.2	3.2	11.7	3.0	12.2	3.04	11.64	3.5
				26.47	28.0f	59.54d	54.58g	52.92e	49.26e			35.71e	46.67b	50.35c	63.73e	47.42d	58.12d	50.17f	53.69d
Natural oil (Naterlo)	625 ml	13.8	6.9	9.4	2.1	5.78	5.38	6.5	4.72	11.6	7.1	4.8	2.9	3.75	3.38	3.96	3.28	5.23	4
				40.06d	72.61b	77.15b	66.26d	69.73c	67.53c			62.76a	67.32a	78.05a	73.1b	74.99a	71.95b	72.36c	69.74c
Zanzalacht	500 ml	12.8	3.8	9.6	3.0	8.4	4.45	8.64	4.16	17.6	5.8	8.8	5.0	12.95	4.15	12.12	4.32	10.38	4.24
				34.0f	28.95f	64.18c	48.65h	58.14d	44.71f			55.0 c	31.04e	50.37c	58.56f	64.12b	53.06e	61.13d	48.88e
Datura	500 ml	19.5	2.0	11.0	0.8	7.5	0.6	8.2	0.64	12.8	6.4	5.2	2.6	3.85	3.63	4.12	3.42	6.16	2.15
				50.36b	64.0d	78.48ab	87.88a	72.85b	83.1a			63.44a	67.50a	79.3a	67.75 d	76.13a	67.7c	74.49ab	75.4a
Damsissa	500 ml	16.4	4.6	16.0	4.2	15.15	4.25	15.32	4.24	18.2	7.2	16.8	7.0	13.65	5.85	14.28	6.08	14.8	5.16
				36.68e	17.83g	49.43f	58.0f	46.88g	49.97e			16.92f	22.22d	46.25d	51.16g	40.38a	45.71f	43.63g	47.84e
Control	Water	20.3	7.2	23.0	8.0	36.55	16.1	35.44	14.48	25.6	18.3	28.4	22.8	36.53	31.03	34.9	29.38	38.17	21.93
L.S.D.$_{0.05}$				1.73	2.45	2.03	1.73	1.84	2.03			1.62	1.62	2.03	1.73	2.03	2.03	1.73	2.03

** Residual effect = Mean number at (5+8+11+15 days)/4 *** Total effect = [(mean of residual ×4) + initial effect]/5
General effect = (*** of 1st spray + *** of 2nd spray)/2

adult stages which give high initial effect after 1st and 2nd sprays and high residual after 2nd spray caused 68.47% and 98% R as a initial effect after 1st spray and 63.65% and 66.45% after 2nd spray, also recorded as a residual effect 77.81% and 71.89% R after 1st spray and 78.53% ‹76.20% R after 2nd spray on nymphs and adult stages, respectively. Damsissa herb extract exhibited the lowest effect throughout the tested period in reducing nymphs and adults of *B. tabaci.* Zanzalacht and the rest of tested materials can be arranged between Sulphonic acid and Damsissa herb extract.

Efficacy of the Tested Compounds on Whitefly Infesting Potato Cultivar, Cara Variety

Data in Table 3 show the effect of the same previous tested materials in the same time but there were treated on Cara variety. All tested materials reducing the numbers of nymphal and adult stages of *B. tabaci* except Damsissa plant extract that gives high % reductions in population as a general effect when compared with Spunta variety. Natural oil and Sulphonic acid caused the high% reductions in population as a genceral effect. Natural oil was the highest efficiency on the nymphs and Sulphanic acid was the highest efficiency on the adults, two previous agents caused 71.32%, 68.25% R on nymphs and caused 61.28%, 66.86%R on adult stage respectively. Zanzalacht fruit extract as a general effect caused 56.08% and 45.44% reduction for nymphal and adult stages, respectively. These results are agree with those obtained by Silva *et al.* (2003), they found that, in the field, the efficiency of the commercial azadirachtin formulation applied at 4 ml/litre was 67.83 for adult and 80.36% R for nymphs, respectively.

Data in Table 4 confirmed the same trend occurring the previous season without oddity. Concerning the population of *B. tabaci* nymphs proved in harmony with the data obtained from the 1st season. The general effect of reduction percentages of *B. tabaci* nymphs can be arranged as 63.59% for Natural oil, 59.81% R for Mospilan, 59.14% for Datura, 57.55% for Sulphonic acid, 56.45% for Zanzalacht and (50.34%, 49.69 % and 49.16% R) for Nomolt, Evisect and Damsissa, respectively, while the mean of reduction percentages of killing for

Table 3. Mean numbers and reduction percentages (% R) of adults (A) and nymphs (N) of whitefly, *B. tabaci* Genn. inhabiting potato Cara variety as influenced by the tested agents (2007/08 season)

Agents	Rate/ 100 liter water	First spray								Second spray								General effect	
		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect**		Total effect***		No. before spraying/ 30 leave		Initial effect after 2 days		Residual effect**		Total effect***			
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
Sulphonic acid	1000 ml	9.4	3.4	4.8 57.11d	1.6 56.71c	5.13 73.25bc	2.2 70.38c	5.04 70.02b	2.08 67.65c	11.6	3.2	5.2 59.66a	2.2 62.52b	4.95 68.19a	2.65 66.95b	5.00 66.48e	3.16 66.06b	5.02 68.25b	2.62 66.86a
Nomolt	50 ml	6.8	2.8	4.2 48.12e	2.0 34.29d	6.05 57.02d	3.0 49.98f	5.68 55.24de	2.8 46.84e	16.2	9.1	11.6 35.56e	7.3 26.2g	9.68 55.94e	7.13 46.63f	12.58 51.5e	7.16 42.54f	9.13 53.37e	4.98 44.69d
Mospilan	25 gm	8.6	3.8	3.4 66.79b	1.6 61.26b	4.6 74.34ab	2.8 66.07d	4.36 72.83a	2.56 65.1d	10.8	5.2	5.4 55.0b	2.0 64.62a	5.0 65.62b	1.95 73.58a	5.08 63.5b	1.96 71.79e	4.72 68.17a	3.64 68.45a
Evisect	125 gm	7.8	3.4	6.0 35.39g	2.6 29.65e	6.95 56.94f	3.4 53.02e	6.76 52.62e	3.24 48.34e	18.0	10.6	15.4 23.0g	8.2 28.83f	12.25 49.17g	7.75 50.02de	12.88 43.93g	7.84 45.78e	9.82 68.16b	5.54 47.06cd
Natural oil (Naterlo)	625 ml	6.4	3.0	2.2 71.13a	1.2 63.2a	3.15 76.52a	1.78 72.9b	3.12 75.44a	1.86 70.96b	9.6	3.2	4.2 60.63a	2.0 51.58c	4.00 68.84e	2.7 51.61d	4.04 67.2a	5.56 51.6c	3.58 71.32a	3.71 61.28b
Zanzalacht	500 ml	9.2	4.2	6.8 37.91f	3.0 34.29d	9.1 61.35e	4.65 48.52f	8.64 56.66cd	4.56 45.92e	20.4	15.8	12.8 43.53d	10.2 40.61e	13.85 58.48d	12.65 46.05f	13.64 55.49d	12.16 44.96e	11.41 56.68d	8.36 45.44d
Datura	500 ml	9.0	4	4.2 60.8c	1.6 63.2a	5.05 71.28c	2.0 76.63a	4.88 89.18b	1.92 73.93a	11.8	4.2	5.8 53.39c	2.4 47.43d	5.65 62.32c	3.1 48.61e	5.68 60.54c	2.96 48..37d	5.28 64.86c	2.44 61.16b
Damsissa	500 ml	10.2	4.6	7.6 37.41fg	3.2 36.0d	7.3 64.77d	6.74 50.53b	7.36 59.3c	6.03 47.63e	23.6	16.4	18.2 28.78f	12.4 30.49f	15.00 52.47f	11.0 54.12c	15.64 47.73f	11.28 49.39cd	11.5 53.52e	8.66 48.51c
Control	Water	12.4	6.6	14.8	7.2	25.45	14.0	23.32	12.64	13.8	20.2	42.2	22.0	50.7	29.65	49.0	28.12	36.16	20.38
$L.S.D._{0.05}$				2.03	1.73	2.87	2.29	2.67	2.29			1.57	1.94	2.03	2.03	1.96	2.29	2.29	2.29

** Residual effect = Mean number at (5+8+11+15 days)/4 *** = Total effect = [(mean of residual ×4) + initial effect]/5
General effect = (*** of 1st spray + *** of 2nd spray)/2

Table 4. Mean numbers and reduction percentages (% R) of adults (A) and nymphs (N) of whitefly, *B. tabaci* Genn. inhabiting potato Cara variety as influenced by the tested agents (2008/09 season)

Agents	Rate/ 100 liter water	First spray								Second spray								General effect	
		No. before spraying/30 leave		Initial effect after 2 days		Residual effect**		Total effect***		No. before spraying/30 leave		Initial effect after 2 days		Residual effect**		Total effect***			
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
Sulphonic acid	1000 ml	8.6	5.2	3.2 63.53e	2.2 61.5e	4.68 66.19c	2.85 71.94e	4.38 60.85b	2.72 69.85a	13.3	4.3	4.2 72.21a	2.2 53.95d	9.65 49.75g	3.3 61.72c	8.56 54.24d	3.21 60.17d	6.47 57.55cd	2.97 65.0a
Nomolt	50 ml	11.9	4.3	8.3 31.65e	3.3 30.16g	7.95 49.98d	3.65 54.71c	8.02 46.31e	3.58 49.8d	13.6	6.2	6.8 56.0c	5.0 27.42ef	8.5 53.96f	4.35 57.61e	8.16 54.36d	4.48 51.57f	8.09 50.34e	4.03 50.69d
Mospilan	25 gm	12.4	3.2	8.2 35.19d	1.8 48.8c	6.25 62.33b	2.65 55.67c	6.64 56.9cd	2.56 54.3c	8.8	6.0	5.8 42.0f	2.6 61.0b	4.03 67.9a	3.4 66.15b	4.38 62.72d	3.24 65.12b	5.51 59.81b	2.9 59.71c
Evisect	125 gm	13.8	4.7	10.2 27.57f	3.2 38.04e	9.4 49.39d	4.75 45.89e	9.56 45.03e	4.44 44.32f	15.4	5.8	11.2 36.0h	4.6 28.62e	8.9 58.93d	4.15 56.44e	9.36 54.34d	4.24 50.88f	9.46 49.69e	4.34 47.6e
Natural oil (Naterlo)	625 ml	13.6	5.9	8.6 38.03c	3.2 50.64b	5.5 69.88e	3.76 65.87b	6.12 63.51a	3.6 62.83b	10.5	5.2	4.6 61.45b	2.1 63.65a	5.3 64.22b	2.6 69.78a	5.16 63.66a	2.5 68.55a	5.64 63.59a	3.05 65.69a
Zanzalacht	500 ml	12.8	3.8	7.8 39.33de	2.6 37.74e	6.8 59.81c	3.75 48.9d	7.0 55.71d	4.56 46.67e	14.8	6.2	9.2 45.3e	5.0 27.42ef	8.4 60.16d	4.45 56.16e	8.56 57.19c	4.56 50.41f	7.78 56.45d	4.56 48.45e
Datura	500 ml	14.2	4.8	8.6 40.65d	3.0 43.13d	6.9 62.13b	2.8 67.45b	7.24 57.83c	2.84 52.58b	12.6	4.8	6.8 52.51d	2.2 58.75c	6.6 62.43c	2.8 64.42b	6.46 60.45b	2.86 63.28c	6.85 59.14bc	2.85 62.93b
Damsissa	500 ml	14.4	4.2	11.2 23.78g	3.0 35.0f	9.3 50.84d	4.2 46.36e	9.68 45.43e	3.96 42.08f	17.8	7.9	12.6 37.71g	6.0 27.03f	10.8 56.68e	4.9 59.56d	11.16 52.89d	5.12 53.05e	10.42 49.16e	4.54 48.57e
Control	Water	15.8	8.2	16.2	9.0	21.3	15.25	20.28	14.0	39.4	16.2	44.8	18.0	56.15	26.75	53.88	25.0	37.08	19.5
L.S.D.$_{0.05}$				1.387	1.500	1.73	1.730	1.730	1.730			1.470	1.270	1.730	1.730	1.730	1.730	1.730	1.730

** Residual effect = Mean number at (5+8+11+15 days)/4 *** = Total effect = [(mean of residual ×4) + initial effect]/5

General effect = (*** of 1st spray + *** of 2nd spray)/2

adult stage can be arranged as (65.69% and 65.01% R) for Natural oil and Sulphonic acid, 62.93% for Datora, 59.71% for Mospilan, 50.69% for Nomolt and (48.57% 48.45% and 47.60% R) for Damsissa, Zanzalacht and Evisect, respectively.

Generally, concerning the effect of potato cultivars on the rate of whitefly adult infestation, Cara variety indicated the lower population densities, while Spunta cultivar was the most favorable for feeding of the *B. tabaci.* Mean population of adult stage infesting Spunta cultivar was 72.93, 60.33 insect while was 49.81, 48.74 insect infesting Cara cultivar at 1st and 2nd seasons, respectively.

These results are agree with those obtained by Abd- Allah *et al.* (2006) and Ibraheem *et al.* (2005) they citied that Spunta variety was the most favorable for feeding of *M. perssica*, *Aphis gossypii* and *B. tabaci.*

The Efficacy of Tested Compounds on the Natural Enemies

Two important predators and one parasitoid were found on potato plantation. The first is the lady bird beetle, *Coccinella undecimpunctata* and the other was the aphid lion *Chrysoperla carnea,* while the parasitoid was *Ertmocerus mundus.*

As show in Table 5, the two predators an one parasitoid were recorded on the two cultivars of potato plants in both seasons. As total numbers, it is obvious that Cara variety at the 1st season had relatively higher numbers of both peredators and parasitoid (244,185) than Spunta variety (196, 124) in the 1st and 2nd seasons, respectively. This coincides with the high level of infestation with *B. tabaci* and other pests on potato plants (Spunta variety). These findings are agree with those obtained by Kotb-Fawzia, K. (2000) who found that *C. undecimpunctata* and *C. carnea* were the two important predators on potato plantation. On the other hand, the most dominant parasitoid was *E. mandus* which represented (55.10% ،46.72%) and (46.77%، 43.24%) from total number of natural enemies populations at 1st and 2nd seasons on Spunta and Cara cultivars, respectively, followed by *C. undecimpunctata* and *C. carnea* which accounted (28.06%, 30.33%), (32.26, 32..43%) and (16.84%، 22.95%), (20.97%، 24.32%) from the total number of natural enemies population on Spunta and Cara cultivars, respectively. These data

Table 5. Effect of the tested agents on natural enemies existing in potato experimental fields during 2007/08 and 2008/09 seasons

Variety	Total numbers of individuals/10 leave for three replicates																					
	Spunta variety											Cara variety										
	First season 2008																					
Agents / Natural Enemie	Sulphonic acid	Nomolt	Mospilan	Evisect	Naterlo	Zanzalacht	Datura	Damsissa	Control (water)	Total	General percentage	Sulphonic acid	Nomolt	Mospilan	Evisect	Naterlo	Zanzalacht	Datura	Damsissa	Control (water)	Total	General percentage
*	1000 ml	50 ml	25 gm	125 gm	625 ml	500 ml	500 ml	500 ml	Water			1000 ml	50 ml	25 gm	125 gm	625 ml	500 ml	500 ml	500 ml	Water		
Ertmocerus mundus	4	7	12	14	15	19	8	11	18	108	55.1	5	9	13	15	15	19	7	10	21	114	46.72
C. undecempunctata	3	4	5	7	6	10	4	5	11	55	28.06	6	8	8	10	7	13	4	4	14	74	30.33
Chrysoperla carnea	0.0	1	3	6	4	5	2	3	9	33	16.84	0	0	5	9	7	10	5	8	12	56	22.95
Total	7	12	20	27	25	34	14	19	38	196		11	17	26	34	29	42	16	22	47	244	
	Second season 2009																					
Ertmocerus mundus	2	4	5	8	6	10	3	8	12	58	46.77	3	7	7	9	8	14	5	10	17	80	43.24
C. undecempunctata	1	4	2	5	2	8	3	6	9	40	32.26	2	6	4	8	3	10	5	9	13	60	32.43
Chrysoperla carnea	0	0	1	4	2	4	2	5	8	26	20.97	0	0	2	6	3	7	4	9	14	45	24.32
Total	3	8	8	17	10	22	8	19	29	124		5	13	13	23	14	31	14	28	44	185	

* Rate of tested compounds application/100 liter water

are agree with those obtained by Salman (1988). Also, the effect of treatment were differentiated from compound to another, where Zanzalacht fruit extract exhibited more safety on the natural enemies on Cara cultivar than Spunta cultivar.

Effects of the Tested Compounds on Potato Yield

Mean yield Kg/ plot for two tested potato varieties at two successive seasons 2007/08 and 2008/09 were shown in Table 6. Data indicated significant differences between means of potato yields which affected with the tested compounds and increased significantly ($p<0.05$) in comparable with untreated ones during the two seasons.

At the two seasons, it could be classified into three categories, the 1st was including Sulphonic acid, Natural oil and Datura with mean yield about 147 and 158 kg/ plot, the 2nd which occupied Mospilan, Zanzalacht and Nomolt with yield about 138.5 and 153 kg/ plot, the last group had the rest treatments (between 134.5 and 145 kg/plot) compared with 120.5 to 130 kg/ plot for untreated plots. Also, Spunta potato variety produced highest yield comared with Cara variety in 1st season than 2nd.

Table 6. Effects of tested compounds on yield (kg/plot) fore both of two potato varieties at two seasons 2007/ 08 and 2008/09

Variety	Season	1	2	3	4	5	6	7	8	Untreated check	L.S.D$_{0.05}$
Spunta	First	158^{a}	143^{e}	146^{d}	143.5^{e}	155^{b}	142^{f}	147^{c}	135^{g}	129^{h}	0.856
	Second	156^{a}	140^{e}	140.5^{e}	141.5^{d}	150^{c}	138.5^{f}	153^{b}	134.5^{g}	120.5^{h}	0.844
Cara	First	157^{a}	138.5^{h}	153^{c}	145^{e}	154.5^{b}	144^{f}	153^{d}	143^{g}	130^{i}	0.841
	Second	155^{a}	144^{e}	147^{d}	137^{f}	153^{b}	139^{f}	150^{c}	136^{h}	123^{i}	0.875

1= Sulphonic acid 2= Nomolt 3= Mospilan 4= Evisect
5= Naterlo 6= Zanzalacht 7= Datura 8= Damsissa

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تأثير بعض مواد مكافحة الآفات على الذبابة البيضاء التي تصيب صنفان من البطاطس

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تم اختبار فاعلية منظف صابوني (حمض السلفونيك) وأثنين من المبيدات الحشرية الحديثة (نومولت ١٥٪ معلق مركز، موسبيلان ٢٠٪ قابل للزوبان) ومبيد حشري تقليدي (إيفسكت ٥٠٪ قابل للزوبان) وزيت طبيعي (ناتيرلو ٩٧٪) وثلاث مركبات من أصل نباتي (زنزلخت، داتوره، دمسيسة) وذلك ضد الحوريات والحشرات الكاملة للذبابة البيضاء *Bemisia tabaci* (Genn.) التي تصيب صنفان من البطاطس وهما صنف سبونتا وصنف كارا وما يرتبط بهما من متطفلات ومفترسات.

تمت التجارب في مركز القنايات - محافظة الشرقية وذلك برش المركبات المختبرة رشتين متتالتين وعلى مدار موسمين زراعيين هما ٢٠٠٧/ ٢٠٠٨ ، ٢٠٠٨/٢٠٠٩ م وأوضحت النتائج ما يلي :

١- أعطي حمض السلفونيك أفضل النتائج في مكافحة الذبابة البيضاء وذلك من خلال النتائج المتحصل عليها فى تواريخ الفحص المختلفة، واعتمادا علي أعلي النسب المئوية لموت الحشرات الكاملة حيث استطاع ان يخفض حموضة سطح الورقة بحيث أصبح غير ملائم لتغذية الذبابة البيضاء.

٢- سبب حمض السلفونيك انخفاضا في النسب المئوية للحشرات الكاملة للذبابة البيضاء علي صنفى البطاطس وتراوح الخفض بين ٨٠,٧٤ ٪ الى ٦٥,٠١ ٪ ، بينما أعطي

الزيت الطبيعي انخفاضا في النسبة المئوية لتعداد حوريات الذبابة البيضاء بين ٧٨,٦٠ ٪ إلي ٦٣,٥٩ ٪.

٣- أظهر كل من مستخلص ثمار الداتورة والمبيد الحشري موسبيلان تأثير أولي مقبول وتأثير متبقي جيد علي كل من طوري الحورية والحشرة الكاملة للذبابة البيضاء بينما سجل كل من نومولت، إيفسكت، مستخلص ثمار الزنزلخت انخفاضا متوسط نسبيا في النسبة المئوية العامة لأعداد الحوريات والحشرات الكاملة علي كل من صنفي البطاطس تراوح بين ٦٢,٣٥ ٪ إلي ٤٤,٦٩ ٪. ومن جهة أخري، فقد اختلف تأثير المعاملات علي الأعداء الحيوية وذلك من مركب إلي أخر حيث أظهر مستخلص ثمار الزنزلخت أمانا أكثر علي صنف البطاطس سبونتا عن الصنف كارا.

٤- بخصوص المحصول أظهرت المركبات المختبرة تأثيرا معنويا مختلفا في الفروق فيما بينهما حيث سجل الصنف سبونتا المعامل بحمض السلفونيك أعلي محصول (١٥٨ كجم/ قطعة تجريبية ١٥٦كجم/قطعة تجريبية) في الموسم الأول والثانى على التوالى، بينما سجل الصنف سبونتا المعامل بالدمسيسة أقل محصول (١٣٤,٥كجم / قطعة تجريبية) وذلك في الموسم الثاني.